IPC1
Integrated Protection Relay

Designed and Manufactured in Australia by
Ampcontrol Pty Limited ACN 000 915 542
Phone: (02) 4903 4800 Fax: (02) 4903 4888
www.ampcontrolgroup.com

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USER MANUAL

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Before You Begin

We would like to take a moment to thank you for purchasing the IPC Integrated Protection Relay. To become completely familiar with this advanced protection and control relay system and to ensure correct operation, we recommend that you take the time to read this user manual thoroughly.

IPC Software

CRN4564

Version IPC1 V01 Initial Release

CRN4902

Version IPC1 V02 2002 12/12/02

Change to Relay 3 selection.

CRN5103

Version IPC1 V03 2004 23/02/04

MCF_VOLTS_MAX increased to 10%

CRN6244

Version IPC1 V04 2007

RTU to Diode Mode, Parameters cleared on change.

CRN7597

Version IPC1 V05 2009

Fan Interlock Delay increased

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1. Overview

1.1 Introduction

The Ampcontrol IPC Integrated Protection Relay (Version IPC1 V5.0) is an intelligent protection relay based on microprocessor technology.

The integrated relay provides the necessary functions required for protecting electrical outlets supplying underground mining machinery. All of the protection functions are combined into a compact, plug-in unit, which can be easily changed out to minimise down time in the event of a problem with the relay.

The IPC Relay can provide machine communication through the use of a Remote Termination Unit (RTU-2) connected between the pilot and earth at the machine end of the trailing cable. Through the use of the RTU-2 Remote Termination Unit the relay parameters are automatically up loaded from a remote machine when a cable is inserted into a power outlet.

The earth fault lockout function tests the resistance of the 3 phase lines to earth by applying an intrinsically safe signal prior to the closure of the main contactor in accordance with AS2081.4 1988. The test is initiated once all starting conditions are met. If the resistance is above the preset level then an automatic high voltage DC "Insulation Test" to earth of the cable can be carried out. If the result of the Insulation Test is above the preset resistance level, the IPC's MCR relay energises, which in turn closes the main contactor. A manual "Insulation Test" is provided as a maintenance/fault finding tool. (When this test is performed the MCR relay does not close at completion of a healthy test).

The Insulation Test allows cable insulation levels to be trended as an aid to preventative maintenance.

The IPC Relay has 5 Digital inputs, which feed into a microprocessor unit. The microprocessor has been programmed to control four output relays. Relay MCR for the main contactor and Relay CBR for the circuit breaker. Relay RL3 can be turned off or configured to follow the Fan Interlock Drive output of the IPC Relay. Relay RL4 when closed applies 110V to the CCMC Cable Connecting Module for the Insulation Test. All of the tripping logic and outlet control is performed by the microprocessor, so that virtually no external control is required (See Typical Connection Diagram IPC-E-001, Page 20).

Extensive information display and monitoring features are included to facilitate fault finding and system trending. This information can be read locally on the Remote Display Module (RDM-1K) or remotely via a communication link.

Opto Isolated Outputs are available for connection to optional LED or Relay Modules to provide additional "run and trip" indications. The Ampcontrol Relay Output Module (ROU) enables these indications to be interfaced with a PLC.

The protection functions provided by the IPC are:

Earth Leakage	-	Section 3-1
Earth Fault Lockout	-	Section 3-2
Earth Continuity	-	Section 3-3
Overcurrent/Overload	-	Section 4-0
Short Circuit	-	Section 4-4
Contactor Fail	-	Section 5-1

Protection trips are stored in a non-volatile memory requiring a reset function before power can be restored to the load. This remains the case even if a power down occurs following a trip condition.

1.2 Remote Display Module

This module (Ampcontrol RDM-1K) consists of a two line - 16 character LCD display, LED status indicators and a tactile keypad.

The display **level** is changed with the Up/Down arrow keys and the Left/Right arrow keys control the display **position**. The display map (Drawing IPC-B-002-21) shows the layout of the various display screens. The module is approved to Ex ia Intrinsic Safety Standards so that it can be installed outside of a flameproof enclosure.

The healthy LED located top centre of the module flashes at 3Hz to indicate healthy communications with the relay. (A flash rate of 1Hz indicates that the module is powered, but is not receiving data).

The module displays the following information:

1. IPC Status.
2. Software version and serial number.
3. Operational information from the protection functions, eg earth leakage current, earth continuity resistance etc.
4. System information including the line voltage and current.
5. Status of digital inputs and relay outputs.
6. Protection trip settings, which can be viewed at any time. Authorised personnel can modify these settings via the RDM, thus eliminating the need to open the flameproof enclosure.
7. Data logging information. The 120 most recent events are logged, with time and date, in a non-volatile memory, for example power-up, trip, reset, close etc. **A review of the first few log events is a useful tool for fault finding.**

The IPC status display is one of the most useful features of the relay's display system and should be viewed as the first step in fault finding. The Status display is the default screen on power up and indicates what the IPC Relay requires in order to allow the outlet to close. These messages are useful to unskilled personnel. If more than one message is active the display cycles around all active messages showing them for 1 second each.

Through the use of the serial communications port, PLC's and SCADA Systems can be configured to display the same messages that appear on the Remote Display Module. This helps to provide consistent information to operators.

1.2.1 Trip / Status Messages:

The following table shows a list of the twenty-eight (28) status messages and the category (type) of the messages. Messages are cleared according to their message category.

Type 1

Messages are cleared by either pressing the **<ENT>** key while on the Status Display Page or by starting a new starting sequence i.e. EFLO test started.

Type 2

Messages are enabled and cleared automatically.

Type 3

Messages are triggered by the respective trip functions and are cleared by resetting the trip function.

Message and Type		Comment
Tripped-No Volts	1	Voltage on load side of contactor is too low
MC Close Fail	1	MCI input did not close within 5 Sec of MCR relay closing
External MC Open	1	IPC detected (via MCI input) that MC was opened – not initiated by the IPC relay
Insulation Alarm	1	Test result at alarm level (1.5 x selected trip level)
Last T: ---------	1	Shows 'Last Trip' record
Need IPC Start	2	Awaiting IPC start digital input
Need RTU Start	2	Awaiting RTU start digital input
Outlet Paused	2	IPC waits 5 Sec between running (or testing) and re-testing
Closing MainCont	2	MCR closed, waiting for MCI feedback (5 Sec max)
. . EFLO Testing	2	In process of EFLO Test (1 second)
Insulat. Testing	2	In process of Insulation Test (2 seconds)
Manual Ins. Test	2	In process of manual Insulation Test
IPC Memory Error	3	Corrupted memory in relay's stored settings
RTU Memory Error	3	IPC detected errors in set up data received from RTU
Trip-RTU Offline	3	IPC can't communicate with RTU
Stopped-RTU PTC	3	RTU PTC input Tripped (open)
Stopped - RTU	3	RTU Stop input Tripped (open)
I Balance Trip	3	Phase Current Balance Function Tripped
Locked Out - Fan	3	Fan interlock system is locking out IPC
Stopped IPC	3	IPC Stop Digital input activated (closed)
Earth Leak. Trip	3	Earth leakage Function Tripped
Earth Cont. Trip	3	Earth Continuity Function Tripped
E/F Lockout Trip	3	Earth Fault Lockout Function Tripped
OverCurrent Trip	3	Over Current Function Tripped
Short Circ. Trip	3	Short Circuit Function Tripped
Main Cont. Fail	3	Main Contactor Fail Function Tripped
Insulation Fail	3	Insulation Test Function Tripped
Running: ----Amps	3	Outlet Closed: shows average of 3 phase currents (in amps)

Table 1

1.2.2 Last Trip Status Messages:

The IPC Relay has several functions, which can stop/trip the outlet and then self-clear. The IPC Relay therefore saves the non-latched trip codes in a register and displays the 'Last Trip' messages in the Status Message Page. (Note that the stop/trip function also appears in the Event Log).

Messages that are displayed **at Last T: ---------**

Message	Comment
EC Leak T	E/C Leakage Trip that provides additional information for E/C Trip
EC Ω Trip	E/C Ohms Trip that provides additional information for E/C Trip
Fan I Stop	Fan interlock Stop
I bal-Trp	Current Balance Trip – Differentiates balance trip from basic over current trip
MC Opened	Main contactor opened – opening not initiated by the IPC Relay
RTU mem. E	RTU Memory error – Errors in set up data from RTU
RTU Off L	RTU Off Line – IPC can't communicate with RTU
RTU ptc T	RTU PTC input tripped
Stopped	IPC Stop Input Tripped
UVOLT Trp	Under Voltage trip – voltage on load side too low

2. Machine Communication

2.1 Remote Termination Unit

The Remote Termination unit is a microprocessor based fully encapsulated module that replaces the diode at the end of the pilot conductor of the trailing cable. It is powered by and communicates via the pilot line. Its non-volatile memory stores the parameters to configure the outlet as appropriate for that machine.

All terminals are fully shrouded, with the pilot and earth terminals being kept segregated from the other terminals. (See RTU-2 General Case Dimensions, Drawing IPB-A-021, Page 26)

The Remote Termination Unit (RTU-2) provides remote stop, start facilities of the IPC Relay's controlled outlet. The circuitry involved for these functions are self-diagnostic and will cause the outlet to turn off if the circuits are earthed or interconnected. This reduces the chance of the outlet operating when not required to do so due to wiring faults. It should be noted that these functions are operational only, and that any **emergency stops should be wired direct into the pilot circuit.**

PTC terminals are provided for a semiconductor thermistor connection. These terminals are protected in a similar manner to the stop and start circuits.

If the remote stop, start and PTC functions are not required, each set of terminals must be bridged, or the IPC Relay will not energise.

Four RTD inputs are provided for PT 100 temperature measuring devices. These terminals could also be used with resistor networks to provide digital information back at the IPC Relay.

RX, TX and 0V terminals are included for the connection of auxiliary devices such as the RTU-CIU1. These terminals allow the input of data from an RS232 source at the load to be transmitted through the pilot of the cable to the IPC Relay's communication port.

On/Off Line Status, machine type, machine number, software version and input status of the Remote Termination Unit can be examined by selecting "Machine Module Information" (Level 2, Positions 1-2). RTD temperature and CIU data is available, Level 2, Position 4-5.

2.2 Machine Type Codes

There are 26 selectable machine type codes available for use in the Remote Termination Unit. The descriptive code is transmitted to the IPC Relay to identify the type of machine connected to the outlet. The codes are selected using the Remote Display Module (Level 9, Position 1).

Belt	Conveyor
SHRr	Shearer
S-Ld	Stage Loader
Hpmp	Hydraulic Pump
Wpmp	Water Pump
cMnr	Continuous Miner
SCar	Shuttle Car
Bk/F	Breaker Feeder
Crsh	Crusher
Fan	Fan
DCB	Distribution Control Box
	BLANK
iFan	**Fan with interlocking**
AFCm	Armoured Face Conveyor Main Gate
AFCt	Armoured Face Conveyor Tail Gate
M-BE -	Mobile Boot End
Bolt	Bolter
HRMr	Hard Rock Miner
Winc	Winch
J-bo	Face Boring Machine
bBlt	Belly Belt
Stak	Stacker
aCar	Add-Car

IGG	Inert Gas Generator
tBlt	Transfer belt
Dplg	Dummy plug

2.3 Machine Type Number

Machine numbers 1 to 40 can be assigned to machines. These numbers are programmed using the Remote Display Module (Level 9, Position 2).

3. Earth Protection Functions

3.1 Earth Leakage

The earth leakage protection function uses a toroid to measure the earth fault current. This function is certified to AS2081.3 1988. A definite time operating characteristic is provided with adjustable trip sensitivity and an adjustable time delay.

When a fault occurs and the trip level and time delay are exceeded a trip occurs. The trip acts in the Main Contactor Relay (MCR) logic and is latched. An earth leakage trip is treated as a special fault and requires an authorised person to perform the reset function. This is achieved by operating and holding the lock button closed and **then** closing the reset button.

When a trip occurs, the "EL" LED on the remote display module is illuminated and the open collector output on the relay is switched on to provide remote monitoring if required.

The leakage current (**EL**) is displayed on the RDM "Earth Fault Information" page as a % of the trip level. When the leakage reaches 100% for the selected time delay a trip occurs.

The trip level is adjustable in 50 mA increments. Range 100 to 500 mA.

The time delay is adjustable in 40mS increments. Range, instantaneous <80mS to 470mS.

3.2 Earth Fault Lockout

The IPC Relay can provide a two-step insulation test as part of the Earth Fault Lockout protection function. The initial test is the mandatory intrinsically safe test and can be followed by an automatic High Voltage 'Insulation Test'. A manual 'Insulation Test' is also provided.

A cable connecting module, which is a resistive isolation device, is used to interface the power conductors to the IPC Relay. Modules are selected in the Group 1 Settings (Level 8, Position 3) for rated line voltages of 110V, 415V, 1000V or 3.3kV.

IPC Cable Connection Modules (CCMC) are the preferred modules and must be used when the 'Insulation Test' function is required.

IPA/IPB Cable Connecting Modules (CCMA) are available for the same rated voltages for use with the IPC Relay. The use of these modules only allows the normal (Intrinsically Safe) EFLO Test to be carried out. The High Voltage DC 'Insulation Test' is not available with the CCMA Modules.

An IPA/IPB CCMA110V Cable Connecting Module is available for use when the relay is installed to control the high-tension supply and/or to provide voltage related functions via 110V PT's. In this application the EFLO and Insulation test functions are **not** provided.

When CCM None is selected the IPC Relay does not provide an EFLO or 'Insulation Test', or voltage functions. Also under voltage checking does not occur.

Note:

The 'CCM None' and 'CCMA110V' Modes MUST NOT BE USED in applications where EFLO is required by mining regulations.

3.2.1 Intrinsically Safe EFLO Test

The initial earth fault lockout function tests the resistance of the 3 phase lines to earth by applying an intrinsically safe signal prior to the closure of the main contactor in accordance with AS2081.4 1988. The test is initiated by closure of the start button once all starting conditions are met (See Section 8.5). This test takes 1 second.

If the value is less than the preset level (See Specifications, Page 17) a trip occurs. The "EF" LED on the Remote Display Module is illuminated and the open collector output on the relay is switched on to provide remote monitoring if required. To reset the relay following an earth fault lockout trip, operate the reset button.

The earth fault leakage level (**EF**) of the three phases is displayed on the RDM "Earth Fault Information" page as a % of the trip level and relates to the last earth fault lockout test performed

3.2.2 Automatic Insulation Test

If a **CCMC** Mode has been selected, in the Group 1 Settings, an automatic High Voltage DC 'Insulation Test' is carried out following a successful Intrinsically Safe Earth Fault Lockout Test (i.e. the resistance is above the preset level selected in the Group 2 Settings Level 9, Position 15).

The HV DC 'Insulation Test' is initiated when the IPC Relay closes its relay output RL4 for 2 seconds. This applies 110VAC to the CCMC Cable Connecting Module. A HV DC voltage is generated in the CCMC Module, which applies a voltage approaching the peak system voltage between each phase and earth.

The IPC Relay measures the voltage on the line and calculates the meg-ohm resistance to earth for each phase. At the end of the test the result is stored in the Event Log as **'it -- . - MΩ'** If the resistance value is above the preset threshold the MCR Relay picks up allowing the outlet to be energised. Additionally, if the result is equal to or below an Alarm Level (typically 1.5 times the selected trip level, see Table 1) the status message **'Insulation Alarm'** is displayed on the Status Page (level 0, position 0). The alarm message is displayed until a new EFLO Test is initiated or the **<ENT>** key is pressed while displaying the alarm message. **'Insul. Alm'** is also recorded in the Event Log.

Ins . TstT: Selection MΩ	Alarm Level MΩ
0.1	0.2
0.2	0.3
0.5	0.8
1.0	1.5
2.0	3
5.0	7.5
10	15
15	20
None	None

Table 1

If the value is less than the preset trip level (0.1 MΩ to 15 MΩ) a trip occurs and is latched and saved in a non-volatile memory. The "EF" LED on the Remote Display Module is illuminated and the open collector output on the relay is switched on to provide remote monitoring if required. An Insulation Trip shares the "EF" LED on the Remote Display Module with an EFLO trip but has dedicated trip messages on the Status Page. To reset the relay following an insulation test fail trip, operate the reset button.

At the completion of a test the leakage level for each phase is retained in memory until the next test is carried out. This can be viewed on the Remote Display Module RDM (Level 3, Position 3).

If the 'Insulation Test' is not selected by either not selecting CCMC or setting **'Ins.TstT:'** value to 'None' then the MCR Relay closes at the completion of a healthy EFLO Test.

The accuracy of the insulation test and expected trip ranges are outlined in the table below. The results from insulation test should only be used as a guide to confirm that insulation remains above the preset threshold. Insulation tests apart from the generated insulation test via the IPC and CCMC should be still carried out on a regular basis for maintenance purposes.

	Actual Fault Resistance (MΩ)	
Trip Setting	**Minimum**	**Maximum**
0.5	0.4	0.6
1	0.8	1.2
2	1.6	2.4
5	4.0	6.4

Table 2

The values in the expected fault resistance range represent ±20% of the nominal value with the exception of the higher end of the 5MΩ range. Trip setting values of 10MΩ and 15MΩ aren't specified above but are available for configuration within the software. These trip settings of 10MΩ and 15MΩ are not recommended for use by Ampcontrol.

Note:

That the start input must be held closed for the duration of the test.
The recommended trip setting values to be utilised for the insulation test trip settings are to be less than 5MΩ. To obtain optimum results the 2MΩ trip setting is recommended.

3.2.3 Manual Insulation Test

A manual "Insulation Test" is provided as a maintenance/fault finding tool. The manual test can only be carried out when the load is not energized. When this test is performed the MCR relay is prevented from closing at the completion of a healthy test.

Before a manual Insulation Test can be performed the following conditions must apply:

1. The Remote Display Module must be online with the Insulation Test page being displayed. This is located on the '**EARTH FAULT INFORMATION**' Page, level 3, position 2.
2. Pilot must be healthy (and any previous trips reset).
3. EFLO function must not be tripped.
4. Insulation Test function must not be tripped.
5. Outlet must not be running.
6. Outlet must not be in the process of 'closing'.
7. Outlet must not be 'Paused'
8. The 'Lock' digital input must be closed.

When the above conditions are met the **<ENT>** key must be pressed and held (for the duration of the test). After 3 seconds the EFLO test will commence. If the test result is healthy the manual insulation test is initiated. The test voltage is applied to the outgoing feeder while ever the above

conditions are held (including holding the **<ENT>** key). The test results are continuously calculated and displayed. The operator should maintain the test at least long enough for the readings to stabilize, this being a function of the cable length. Once the test is completed (usually by releasing the **<ENT>** key) the results are held in memory until another insulation test is commenced either manually or as part of the starting sequence, or IPC control power is lost.

Note that the manual test can be carried out even if the '**`Ins.TstT:`**' selection is set to 'none' (ie the automatic insulation test in the starting sequence is turned off). If the 'CCM' selection (see section 3.2) is not a CCMC Cable Connecting Module, then the manual test will only perform an EFLO test.

The status of the manual insulation test is shown on the Insulation Test Information Page (level 3, position 3). A single letter following **'Mt:'** indicates the status of the test:
`Mt:x` : Manual Test is blocked - by any one or more of the conditions 1 to 8 above.
`Mt:e` : Only the **<ENT>** key is required to initiate the manual test.
`Mt:t` : The manual test is timing through the enabling period (3 seconds).
`Mt:A` : The manual test is Active. The display will show measured values.

3.3 Earth Continuity

The earth continuity function tests for the continuity of the earthing between the outlet and the machine, via the pilot core in the trailing cable. This is in accordance with AS2081.2 1988. The pilot core is also used to transfer data when a Remote Termination Unit is used to achieve machine communication.

The IPC relay can be configured to operate in either diode or RTU mode. The mode is selected in "Pilot Type", (Level 8, Position 1) and determines what terminating device the relay is looking for on the pilot.

Note: The Remote Termination Unit will only be recognised by an IPC Relay and will not be seen as a diode by other earth continuity devices.

The relay measures the resistance of the pilot - earth loop and the leakage between the pilot and earth conductors. The leakage measurement ensures that pilot to earth faults are detected. If the pilot - earth loop is not healthy a trip occurs (See Specifications, Page 17) which in turn opens the main contactor control circuit. The fault can be configured as latching or non-latching. This allows the user to determine if the fault is manually or automatically reset once the pilot - earth loop is healthy. The selection is either "Pilot Latch: On" or "Pilot Latch: Off" (Level 9, Position 11). To manually reset the relay, operate the reset button.

The "EC" LED on the Remote Display Module is illuminated and the open collector output on the relay is switched on to provide remote monitoring if required.

The earth continuity resistance (**ECR**) of the pilot – earth loop and the leakage (**L**) between the pilot and earth conductors is displayed on the RDM "Earth Fault Information" page as a % of the trip levels. When either value reaches 100% a trip occurs.

Pilot Trip Time is adjustable to allow for operation in noisy electrical environments. The following trip times are available:
80, 120, 160, 200, 300, 400 and 500mS

A setting of 120mS should be suitable for most installations. Long time delays (>200 ms) should only be used where necessary. Consequence of long trip times should be thoroughly assessed from a safety point of view before using the higher values.

4. Current Related Functions

4.1 Basic Overcurrent Protection Functions

Two current transformers are used to measure the three line currents. The measured currents are used to implement the following protection functions:
(a) Overcurrent or Motor Overload
(b) Short Circuit
(c) Phase Current Balance

Full load settings cover a range from 7.5 Amps to 464 Amps. A current range and current multiplier are utilised to select and store the full load current value in the non-volatile memory. This forms the basic reference level for the overcurrent protection functions.

The current range is selectable in 4 Amp increments between 60 and 116 Amps. The current multiplier is selectable at 1/8, 1/4, 1/2, 1, 2, 4 times. (See Section 7.1)

Example - Overcurrent Setting

To obtain a full load current of 152 Amps select a current range of 76 Amps and a multiplier of 2.

Two curve types can be selected and a time multiplier modifies the basic trip time characteristic. There are eighteen (18) multiplier settings that can be selected ranging from 0.005 times to 1.0 times (See Section 7.1).

It should be noted that settings 0.005, 0.01, 0.015, 0.02, 0.03 and 0.04 are positioned after setting 1.0 in the stored setting's list (Level 9, Position 4).

The instantaneous current in each of the three phases can be displayed on the RDM (Level 5, Position 1). The three phase currents are displayed, as a % of the overload set current. The average current value is expressed in Amps and is displayed at Level 5 and the Status Page (Level 0, Position 0).

Following a trip condition the following conditions must be met to achieve a reset:
a) The IPC reset input must be closed
b) The trip accumulator must be less than 80%

4.2 Overcurrent Characteristic

If the selected overcurrent type is "vInv", then a very inverse overcurrent characteristic set of curves are available for selection. (See "vInv" Curves, Drawing IPB-B-004, Page 22).

The three phase currents are compared and the highest current is used to calculate the trip time. If the current exceeds the selected full load current an "overcurrent trip accumulator" increases at a rate determined by the current and the selected curve. This can be displayed on the RDM (Level 5, Position 2). When the current falls below the selected full load current the trip accumulator reduces towards zero rapidly, however, if the overcurrent condition persists so that the trip accumulator reaches 100% then a trip occurs. If viewed during start up the trip accumulator can help determine if overcurrent settings are correct.

If a trip occurs the "OC" LED on the Remote Display Module is illuminated and the open collector output on the relay is switched on to provide remote monitoring if required.

To reset the relay following an overcurrent trip, operate the reset button.

4.3 Motor Overload Characteristic

The overcurrent type "m-OL" is used when a motor overload characteristic is required (See "m-OL" Curves, Drawing IPB-B-005, Page 23). This characteristic uses a thermal model of the motor to determine the tripping characteristic. The motor overload curves are shown for both cold and hot conditions. The hot curve corresponds to the trip time after the motor has been running at the selected full load current indefinitely.

The motor manufacturer's data should be consulted to select the time multiplier appropriate for the motor being protected. Typically, the capacity of a cold motor is given at six times its rated current. The IPC trip curves can be used to select the time multiplier, which best suits the motors overload capacity.

Thermal Model

Thermal modeling is based on a thermal time constant of 30 minutes (time multiplier setting of 1.0 times). The time multiplier can reduce this value to a minimum thermal time constant of 1.5 minutes (time multiplier setting of 0.05 times).

The three measured phase currents are squared and added together to provide the heating input into the thermal model.

While the main contactor is closed, the cooling output from the thermal model is calculated to achieve the necessary time constants.
When the main contactor is open a "Cooling Multiplier" is used to modify the basic time constant. This can be used to account for the reduced cooling capacity while the motor is not running (when applicable). This multiplier is selectable at 0.2, 0.3, 0.4, 0.5, 0.8, 1.0, 2, 5, 10, 20, and 50 times.

A selection of 1.0 times sets the motor off cooling rate equal to motor running cooling rate. This selection is appropriate where cooling is maintained even when the motor is stopped, eg water cooled motors.
When 0.2 times is selected the motor off cooling rate is reduced to 20% of the motor running cooling rate.

A selection of 50 times effectively disables the thermal memory. With this selection, as soon as the main contactor opens, the thermal model resets quickly so that a cold restart is achieved.

Caution: Repeated restart attempts in this condition may damage the motor.

Typical fan cooled motor protection is based on a setting of 0.4, however, for the best protection consult your motor manufacturer.

The thermal model continues to simulate the motors thermal behaviour even if the power is removed from the relay. When power is restored the thermal memory would be at the same level had there been no loss of power.

The "OC Trip" Accumulator shows the state of the thermal model: 0% = Cold, 100% = Trip.

When a trip occurs the IPC Relay cannot be reset, by operation of the reset button, until the accumulator is less than 80%. In order that an emergency restart on a hot motor can be achieved a reset of the thermal memory is possible by selecting Level 5, Position 3 on the Remote Display Module. The display shows:

ZERO THERM MEM?
RESET + LOCK[100]

The [100] indicates the current value of the trip accumulator. Operating the lock and reset buttons simultaneously while the above display is being shown will zero the OC Trip Accumulator after 1.5 seconds.

Indication of the trip condition for motor overload is the same that occurs for an overcurrent trip.

4.4 Short Circuit

The short circuit function has a definite time characteristic. If the current exceeds the selected level for the pre-set time then a trip occurs.

The "SC" LED on the Remote Display Module is illuminated and the open collector output on the relay is switched on to provide monitoring if required.

To reset the relay following a short circuit trip it is necessary to operate and hold the lock button closed and then close the reset button.

The relay can be programmed so that a short circuit condition can trip either the "CBR" relay or the "MCR relay. This can be achieved by selecting either relay at the "SC Relay" selection in the non-volatile memory (Level 8, Position 5) on the Remote Display Module. Normally the "CBR" selection would be used. If "MCR" is selected then the user must ensure that the interrupting device that is operated by the short circuit trip output of the relay has sufficient current interrupting capacity at the system voltage for the situation in which it is installed.

The short circuit trip level is adjustable from 3 to 10 times (full load current) in 0.5 increments. The trip time is selectable from 20 to 160mS.

4.5 Phase Current Balance

Phase current balance protection is selected via the "Cur Bal Trp" selection (See Section 7.1). The current balance measurement is displayed on the Remote Display Module and is calculated as:

$$\text{Ibal} = \frac{\text{MAX } \Delta \text{ I} \times 100\%}{\text{Iave}}$$

Iave = Average of the 3 phase currents

MAX Δ I = The maximum deviation of a phase current from the average

The trip level is selectable at 5%, 10%, 20%, 50% and off.

The phase current balance protection is inhibited until the average current exceeds both 20% of the selected full load current and the selected balance trip level.

If the trip level is exceeded, a timer is triggered. If the imbalance remains above the set level for more than two seconds the relay trips. The event log records "Ibal" to differentiate it from a true overcurrent trip.

The status of the timer is displayed adjacent to the "Ibal" value (Level 5, Position 2). A trip condition occurs when the timer reaches 100%.

5. Voltage Related Functions

5.1 Main Contactor Fail Protection

The Main Contactor Fail (MCF) protection operates if the Main Contactor (MC) fails to function by either:

1. Failing to open when required. This is achieved by comparing the state of the main contactor (via the Main Contactor Input MCI) against the state of the MCR relay output. This test provides "Frozen Contactor Protection".
2. Failing to maintain insulation across the contacts when the contactor is open. The Cable Connecting Module is used to measure the voltage on the load side of the contactor. If this exceeds 10% of the rated line voltage, a trip will occur.

This test provides "Loss of Vacuum Protection". This function is inhibited immediately after the main contactor opens to allow for back EMF voltages generated by some motors to dissipate. The inbuilt time is adjustable from 2 to 20 seconds (See Section 7.1).

A main contactor fail trip causes the CBR relay to de-energise, which trips the circuit breaker. An internal battery backed flag in the IPC Relay is also tripped. A LED on the front panel of the IPC Relay begins to flash.

The "MCF" LED on the Remote Display Module is illuminated and the open collector output on the relay is switched on to provide remote monitoring if required.

To reset the flag, access to the relay is necessary. In the case of flameproof equipment the power has to be removed in accordance with AS1039. The reset button is accessible through the front fascia of the relay and must be pressed for 1 second.

5.2 Undervoltage Trip

Undervoltage protection is enabled as soon as the main contactor is closed (indicated by closing the MCI input). If any of the phase voltages drop below the selected trip setting of the nominal line voltage for 800mSec then the outlet is stopped. This is recorded in the event log as "uVOLT Trp".

The trip level is selectable from 20% to 80% in 10% increments (Level 8, Position 4) on the Remote Display Module.

5.3 Voltage Metering

The cable connecting interface module (CCMC/CCMA) is also used to provide line voltage metering.

The outgoing line voltages for each of the 3 phases are displayed as a % of the selected rated line voltage on the Remote Display Module (Level 4, Position 1). The maximum reading is 120%

Line voltages from 415V, 1000V, 3300V or 110V are configured when the appropriate CCMC/CCMA Cable Connecting Module is selected in the Group 1 Settings (Level 8, Position 4) on the Remote Display Module. This parameter is also used in determining the cable fault leakage levels.

6. Fan Control

6.1 Fan Interlocking

A fan interlocking facility can be selected to prevent outlets from being energised until a mine section ventilation fan is operational. This facility eliminates the need for dedicated outlets. The configuration of the fan interlocking system is shown on Drawing IPB-B-002, Page 24.

Each relay is linked together via the "FIO" (Fan Interlock Input/Output Terminal).

For single fan operation a 100 Ω resistor is connected between this link and earth. This causes all relays in the system to default to a "Slave" mode waiting to receive an interlocking signal before they can run.

For dual fan operation it is necessary to connect two 100Ω resistors in parallel to the FIO Terminal, otherwise all FIR Inputs will read as off and the slave outlets will not run.

When an IPC Relay detects a Remote Termination Unit that has been programmed with the special machine type identifier "iFan" that particular relay switches to a "Master" configuration. This relay controls the slave outlets allowing them to run when the fan current is above the selected threshold setting.

Each relay has the ability to read and drive the FIO link via the Fan Input Read (FIR) processor input and the Fan Interlock Drive (FID) processor output. The status of the input/output can be viewed on the Remote Display Module - "Relay and Digital Input Status" Section (Level 6, Position 4).

The outlet control in each IPC Relay has been designed so that an outlet will not run unless either:

(a) The FIR input is "ON", or

(b) The Remote Termination Unit connected to that IPC has been programmed with machine type "iFan".

The result of these conditions is reflected in an internal Fan Run Status (FRS) bit. The status of this can be viewed on the Remote Display Module. If the FRS is on, then the fan interlocking system will allow the associated outlet to run.

Relay 3 can be selected to be either non-functional (off) or can be configured to follow the Fan Interlock Drive (FID) or Fan Interlock Read (FIR) outputs of the Relay.

For single fan operation select FID or FIR. Relay 3 will energises as soon as current is above the preselected threshold.
If FID is selected for dual fan operation then Relay 3 will energise as soon as current from either fan is above the preselected threshold. If FIR is selected Relay 3 will only energise if the current from both fans are above the preselected threshold.

6.2 Interlocking Sequence

The fan interlocking operates as follows:

1. Each IPC powers up with the FID output turned off. At this point the FIR input on all IPC Relays will read, as off, therefore no outlet will run.

2. When a machine is plugged into an outlet that has its Remote Termination Unit programmed "iFan" then that relay will be allowed to run when requested. (Provided there are no protection trips, stops etc preventing its operation).

3. When that outlet is running **and** the current is above the preselected current threshold, a 5 second time delay is initiated. At the completion of this delay, that IPC Relay turns on its FID output. The fan current threshold is adjustable from 32% to 96% of full load current in 8% increments (See Section 7.1).

4. Detecting the interlocking signal via their FIR inputs then enables all other IPC Relays on the FIO link.

5. If at any stage the fan current drops below the threshold, or the fan is stopped, the master IPC Relay turns off the FID output. This causes all slave IPC Relays to stop.

If fan interlocking is not required, the system can be disabled by connecting a 10kΩ/1W resistor from the FIO Terminal (Terminal 9) to OV (Terminal 12) on each relay. In this case the FIO Terminals are not interlinked. This causes the FIR inputs to read high at all times.

An auxiliary fan being used in this situation would have its Remote Termination Unit programmed with machine type "Fan".

7. Adjustable Settings

7.1 Parameter Groups

There are two groups of adjustable settings contained in the IPC Relay's non-volatile memory. Both groups can be viewed and modified via the Remote Display Module.

The first group of settings is always stored in the relay and relates to parameters, which are linked to the system rather than the particular load connected to the outlet.

Group 1 Settings:

Pilot Mode:	Determines if the pilot is to be terminated with a diode or remote termination unit
EL Time:	Sets the trip time for the earth leakage protection
EL Sens:	Sets the sensitivity trip level for the earth leakage protection
EFLO:	Selects the Cable Connection module to be used with the IPC Relay
U/V Trip:	Selects the undervoltage trip threshold as a % of line volts
SC Relay:	Selects which output relay (MCR or CBR) is tripped in event of a short circuit trip
EC Time:	Sets the trip time for the earth continuity protection
Relay 3:	Selects "off", "FID" or "FIR" operation of the relay

The second group of settings consists of parameters that are related to the load connected to the protected outlet. These settings are stored, retrieved to/from the memory in the IPC Relay or the memory in the Remote Termination Unit, depending on the "Pilot Mode" setting. Figure 1 shows how the memory is "switched". If a diode pilot mode is selected the IPC Relay reads and writes to and from the relay's internal memory for the group 2 settings.

If a RTU Mode is selected the settings are sent to and retrieved from the memory in the Remote Termination Unit.

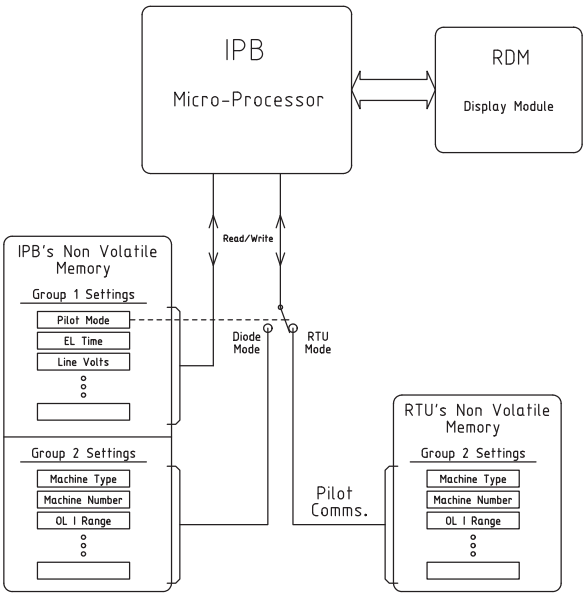


Figure 1

Group 2 Setti

RTU MC Type:	Selects the RTU descriptive code transmitted to identify the machine connected to the outlet.
RTU MC No:	Selects the assigned machine number to be transmitted by the Remote termination Unit.
OC I range:	Sets the basic current range
OC I mul:	Combines with OC range to define the full load current
OC Type:	Selects either very inverse overcurrent or motor overload protection
OC t mul:	Modifies the basic overcurrent time curves to achieve the desired trip times
Cool mul:	Allows the cooling rate of the thermal model to be modified
Cur Bal Trp:	Adjusts current phase balance trip
SC I trip:	Sets the short circuit trip level
SC Trip t:	Sets the trip time for the short circuit function

Pilot Latch:	Determines whether earth continuity trips are self resetting or not
B-emf TIME:	Adjustable time delay to inhibit main contactor fail following opening of main contactor
Fan i Level:	Sets the fan current threshold at which other outlets are allowed to run
Remote Start:	When "Yes" is selected the IPC Relay ignores the local start input. When "No" is selected the local start/stop inputs control the relay
Ins . TstT:	Sets the trip threshold or disables the function

7.2 Changing Settings

The procedure for adjusting the settings is independent of where the values are stored. The pilot mode should be checked prior to making any other adjustments to be certain the changes are made to the desired memory.

1. Ensure the outlet is stopped.
2. For Group 2 Settings in RTU Mode, ensure RTU is on line.
3. Display the parameter that has to be changed on the Remote Display Module's liquid crystal display.
4. Momentarily operate the lock push button. A warning message appears.
5. Press the enter button to acknowledge the warning message and to confirm that a change is desired.
6. Use the left and right arrows to step through the allowable values until the desired new setting is displayed. If the right arrow key is pressed when viewing the last parameter the display wraps back around to show the first parameter.
7. Press the enter button to indicate that the value is the required setting.
8. Momentarily operate the lock push button. The display will show a confirming message, then return to the viewing level.

If the up or down keys are operated during the procedure the IPC Relay aborts the modifying sequence.

When changes have been made to the stored values, the old value and the new value are stored in the event log.

A separate log immediately proceeds this recording the time and date that the change was made.

Note 1

While in the diode mode the IPC Relay can be preset with operating values in the Group 2 memory prior to switching to the RTU mode. When in this mode the relay uses the Remote Termination Unit settings. If the Remote Termination Unit is replaced with a diode and the "Pilot Mode" switched back to diode, the settings will revert back to the values preset in the IPC Relay.

Note 2

When the relay has been selected for RTU Mode the RTU must be on line before the RTU set up mode can be entered.

8. System Control

8.1 Digital Inputs

The IPC Relay has five digital inputs, which are all voltage free contact inputs. Shorting the two input terminals together activates them. The inputs are MCI, start, stop, lock and reset.

The status of inputs can be displayed on the Remote Display Module (Level 6, Positions 2 and 3).

8.2 Output Relays

The IPC Relay has output relays to control the main contactor (MCR) and the circuit breaker (CBR). Both relays are fail safe with respect to power supply loss and are controlled on the basis of protection functions.

Relay 3 has a selective function. (See section 6.1). RL4 applies 110V for the Insulation Test. (See section 3.2.2).

The status of the relays can be displayed on the Remote Display Module (Level 6, Position 1).

8.3 Open Collector Outputs

The IPC Relay has eight open collector outputs, which are driven through opto couplers to provide additional indication if required. These can be used to drive LED's, or additional relays (with appropriate drive circuitry). The eight outputs correspond to the LED's on the display module, turning on whenever the corresponding LED is flashing. The signals are available on the IPC Relay's base pins 35-42, and the common is on pin 34.

Contact Ampcontrol if further information is required about these outputs.

8.4 Outlet Control

The outlet can be energised by local or remote operation depending on the "Remote Start" option. The selection is "Yes" or "No" (Level 9, Position 14).

RTU Mode:

If "Yes" is selected the relay ignores the local start input thus allowing operation of the outlet from the remote machine. Both the remote and local stop buttons will turn off the outlet.

If "No" is selected the local start/stop buttons control the outlet. The Remote Termination Unit's start, stop and PTC terminals must be bridged to energise the outlet .

Remote Operation in Diode Mode:

In this mode the stop/start station is connected in the pilot. (See Typical Connection Diagram IPC-E-001, Page 20). The pilot has a hysteresis of 100 ohms. This is to allow a 100 ohm resistor to be connected across the start button. The hysteresis is linked to the main contactor input (MCI). If MCI is open, then the earth continuity will trip at 45 ohms. If the MCI is closed, the earth continuity trips at 145 ohms.

It is also necessary to bridge the local start button or start input on the relay, on the outlet controlled by this method.

Both the remote and local stop buttons will turn off the outlet.

Stop/Start functions are operational only. **Emergency stops should be wired direct into the pilot circuit.**

8.5 Operational Sequence

Before an outlet can be energised the following conditions must apply:

(a) No protection faults present
(b) Fan interlocking enabled
(c) Stop input open
(d) Local and remote start inputs closed
(e) RTU stop and PTC inputs closed

Once these conditions are obtained a cable fault lock out test is performed automatically. This takes 1 second. If the result of this test is satisfactory the IPC Relay goes into the run mode and the MCR relay picks up.

The "RUN" LED on the Remote Display Module is illuminated and the open collector output on the relay is switched on to provide remote monitoring if required.

A time delay of 5 seconds is allowed for the Main Contactor Interlock (MCI) to close. If it does not close within this time, then the run mode is exited.

If a stop input is closed while the relay is in run mode, the run is cleared, and the MCR relay de-energises. The event log reads "Stopped". If a stop input is closed during a cable fault lockout test, then the test is aborted.

While the main contactor is closed, the MCI input is continuously monitored. If it opens, the run is cleared and the MCR relay de-energises. In this case the event log records "MC Opened" which indicates that the outlet was turned off by something other than the IPC Relay, eg open circuited main contactor coil or control supply.

It should be noted that if the main contactor does not close when the MCR relay closes and the start/stop conditions are maintained, then the IPC will cycle through the following start sequence: testing, run, stopped, pause then repeat the sequence while ever the start input is closed.

9. Event Log

A real time clock/calendar is included in the IPC Relay. This combines with the non-volatile memory to provide a data-logging feature. This log sequentially records the time, date and details of the most recent event. A chronological list of the previous 120 events is stored.

The event log can be automatically scrolled so as to view the entire log. To achieve this press "Enter" followed by the "Right or Left" arrow keys to commence the scroll. The log will scroll one log per second in the direction of the arrow key pressed. Press "Enter" to stop the scroll at the desired log.

A typical display shows:

```
LOG 10: EL TRIP
MO 15/05 09:46:21
```

This records that an earth leakage fault caused a trip condition on Monday, 15 May at 9.46am. Log 10 indicates that it is the 10th log in the list. **Log 1 is always the most recent event.** Each time a new log is recorded, the 120th log is removed from the list.

The following events are logged:

Power Up	The instant that power is applied to the relay
Pwr Down	Removal of power from the relay

MCR Close	Closure of the Main Contactor Relay
Stopped	Stopping of the outlet by operation of the local stop button
RTU Stop	Stopping of the outlet by operation of the remote stop button
MC Opened	Main Contactor has opened but not initiated by the IPC Relay
MC Fail	Main Contactor Fail Function Trip
CloseFail	Indicates that the MCI Input did not close within 5 seconds of MCR closing
EC Ω Trip	Pilot/Earth continuity loop exceeds 45 Ohms
EC Leak T	Leakage resistance between the pilot and earth is less than 1500 Ohms
EL Trip	Earth leakage protection tripped
EFLR Fail	Earth fault lock out test has failed
SC Trip	Trip condition of short circuit protection
OC Trip	Trip condition of overcurrent or overload protection
I bal-Trp	Current balance trip condition
RESET	Records resetting of a protection trip function
Setup Mod	Records that set up data has been modified
Fan I Stp	Outlet stopped by fan interlock
uVOLT Trp	Records that voltage was not present on at least one outgoing phase when the main contactor was closed
MCF F Trp	Internal battery backed main contactor fail trip
RTU ptc T	Operation of the remote termination units PTC
T-mem Rst	Thermal memory has been manually reset to zero
Mem.ERROR	Records that the relay's non-volatile parameter memory has been corrupted
µ- P reset	Internal microprocessor reset
Tmem Loss	The thermal memory data has been corrupted
RTU mem. E	Records that the remote termination unit's non-volatile memory has been corrupted or remote termination unit has gone off line while the outlet is running.
Outlet On	Records RTU machine code and number when main contactor is closed (proceeded by MCR closed). This log only appears when in RTU mode.
RTU Off L	Indicates a loss of communications with the RTU.
Meg Ω Trp	Insulation Test failed
IT: -- . -MΩ	Records the result of the Insulation Test
Insul . Alm	Result of Insulation Test is equal to or less than the alarm level

10. Time & Date

If there is a need to adjust the real time clock, carry out the following procedure:

1. Using the Remote Display Module select the time and date information page (Level 7, Position 1) to display the Day, Month, Year, Hours and Minutes.

```
- - - - - - - - - - - - -
MO 150595 09:46
```

2. Press the enter key. A "v" will appear in the top line above the minute section. This indicates the number to be changed.

3. Use the left and right arrow keys to move the "v" to the desired position.

4. Press the enter key. The "v" now changes to a "?" The right arrow key is used to increment the allowable values, once the desired value is obtained, press the enter key again. The "?" returns to a "v".

5. Repeat steps 3 and 4 until the correct time and date is displayed.

6. With the "v" showing press the lock push button. The "v" then changes to "E". (This is a prompt to press the enter key).

7. Press the enter key. At that instant, the seconds are zeroed and the selected time/date information is transferred to the internal clock.

If the battery voltage is low the time will zero and the date will reset to 1st January on power up. If the battery is flat or faulty the relay is likely to trip on main contactor fail on power up.

Note: The date and time are used only to time stamp the events in the log (which are recorded sequentially regardless of the date/time). Date and time data is not used for any control functions.

11. Remote Data Communications

The IPC Integrated Protection Relay has the facility for connecting remote monitoring equipment. This can be in the form of either the Remote Display Module or other peripheral equipment such as PLC's.

For PLC applications each integrated protection relay is connected to a Serial Interface Module (IPSI), which has its output drop connected to a DNET-IP2 Protocol Converter. The Protocol Converter provides the communications link to a PLC (See User Manual E06510 for further details).
The Ampcontrol DNET-IP2 Serial Communication System transfers data and commands between the Host System and the modules using RS232, RS422 and RS485 protocols.

12. Installation & Wiring Instructions

The IPC Integrated Protection Relay is a microprocessor based protection relay that has the facility for connecting intrinsically safe remote monitoring equipment. This can be in the form of either the Remote Display Module or other peripheral equipment such as PLC's.

These instructions have been designed to assist users of the IPC Relay with installation and special wiring techniques required maintaining the integrity of the intrinsically safe circuits.

12.1 Installation

(A) IPC Integrated Protection Relay

The IPC Relay has a powder coated sheet steel enclosure designed to be mounted into existing enclosures, ie flameproof equipment or other enclosures of adequate IP rating.

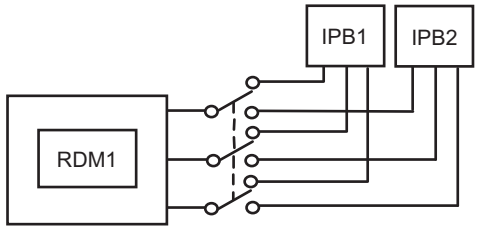
The relay is designed to operate when mounted either laid down flat or in a vertical position. Vent holes are provided at both the top and bottom of the relay to assist in the cooling of the electronics inside the relay. These vents should not be blocked or restricted in any way.

When installing the IPC Relay care should be taken to ensure sufficient space is allowed around the relay for the ease of change out during routine maintenance.

Connections to the IPC Relay are made via a plug in base. This base is to be securely fastened to the enclosure in which it is being installed. The base is clearly labelled for ease of terminal location and identification. The base sockets are factory adjusted so that they are able to move to assist in alignment when the relay is inserted. **Do not tighten socket mounting screws.** For installation mounting see drawing **IPBA029** (Page 35)

(B) Remote Display Module (RDM)

The Remote Display Module is an intrinsically safe device (Ex ia), designed to be mounted into the cut out of an IP54 enclosure and can therefore be mounted external to the switchgear it is controlling. To provide maximum benefit to the operator, one RDM is normally used per relay. This allows information from several relays to be simultaneously accessed and compared. However, if space restrictions preclude this, a compromise is to use one (1) RDM to monitor and control more than one IPC Relay. In these circumstances the following wiring arrangement is recommended:



The 3 pole change over switch must have sufficient creepage and clearance between IPC Relay channels in accordance with AS2381.7, 1989, Section 3.

(C) CCMC Cable Connection Module

The Cable Connection Module (CCMC) is a resistor-diode barrier, which interfaces between the power circuit and the IPC Relay. It also provides an automatic High Voltage DC 'Insulation Test' following a successful Intrinsically Safe Earth Fault Lockout Test. The CCMC is housed in an encapsulated module.

Ensure that the earth connections are reliably installed, as this is the basis of protection, for all barriers, including the CCMC.

(D) Overload & Earth Leakage Toroids

Current transformers are not ideal devices and if correct procedures are not followed during installation, nuisance tripping can result.

If, for example, we consider a single phase earth leakage system where active and neutral pass through a toroid, then at all times currents in the two wires are equal and opposite so that the net current through the toroid is zero. An ideal current transformer would have all the flux from each wire contained in the core and so would accurately add the opposing fluxes to get a net result to zero. A real current transformer has "leakage fluxes". That is, a very small proportion of the total flux from each cable is not contained in the core, but in the space outside it and as result it may link some turns but not others, depending on the positioning of the cables.

The effect of this is that a small output may be obtained from the CT where none would arise if the device were ideal.

The size of the error will vary from CT to CT of the same type because of slight differences in the core and the symmetry of the winding.

Problems caused in this way become worse as CT sizes increase, as currents increase and a decrease occurs in the symmetry of the cables. Nuisance tripping tends to occur when the total current rises, such as when a large motor is started.
This is not normally a problem with the current levels found in flameproof enclosure applications. To help avoid problems in other applications, select the smallest internal diameter CT, to suit the cable size.

(E) Toroid Installation Guide Lines

1. Keep cables as close to the centre of the toroid as possible. Do not tie them to one side of the toroid. Remember to aim at symmetry.
2. Do not bring the cables back past the toroid within one diameter of the CT, trying to cram cables into a small space reduces symmetry and may lead to problems, which are difficult to solve.
3. Avoid placing the CT near any device, which produces magnetic fields - whether it is a transformer or other cables. Try to maintain several CT diameters clearance.
4. Many small cables tend to be worse than say three large ones. Try to position the CT in the circuit with this in mind.

12.2 Wiring Installation

The connections to the IPC Relay consist of a mix of intrinsically safe circuits through to "high" voltage supplies and relay contact circuits. To ensure the integrity of the intrinsic safety is maintained and to reduce induction from high voltages, care needs to be taken in the layout of the wiring and the installation.

For installations on high voltage systems (>3.3kV) it is advisable to install a power supply filter, eg Schaffner FN612-1106 (1A, 250VAC chassis mounted filter) adjacent to the IPC Relay. The earth should be connected to Pin 7 on the relay as directly as possible.

The IPC Relay's approval requires that the relay is installed in accordance with the Australian Standard for Intrinsic Safety Installation AS2381.7. Anyone installing IPC Relays should therefore have a good understanding of AS2381.7.

(A) Intrinsically Safe Circuits:

Duty	Pin	Signal	Recommended Cable Type
Pilot Core	6 7	Pilot Earth	Single core screened Screen = 0V (See note 1, page 15)
Serial Comms Port	8 9 10 11 12	+Vsc TXE TXD RDI OV	Four core screened *Screen = OV
Remote Display	13 14 12	Data +Vdm OV	Two core screened *Screen = OV

Note 1: That the 0V is internally connected to the IPC Relay's earth (pin 7). The screen therefore should NOT be earthed at any other point.

It is recommended that these circuits be separately loomed from all non-IS circuits.

(B) Low Voltage Signals

Although these signals are not IS signals themselves, they connect to the low voltage side of the IPC Relay's internal "infallible" transformer. This transformer is designed and certified to comply with section 3.2.2 of AS2380.7. This means that it "is not liable to become defective in such a manner as would lower the intrinsic safety of the circuit", (from definitions section of AS2380.7). Care must therefore be taken to ensure these circuits cannot come into contact with higher voltages (eg via insulation breakdown, or broken wires etc). It is recommended that these circuits be run in a separate loom from both the IS circuits and the "high" voltage circuits. To ensure that interference is kept to a minimum, the following cabling is recommended.

Duty	Pin	Signal	Recommended Cable Type
Earth Leakage Toroid	1 2	EL1 EL2	Two core screened Screen = Earth
Cable Connection Module	3 4 5 7	VcmA VcmB VcmC Earth	Three core screened Screen = Earth
Current Protection Transformers	15 16 17 18	Ia1 Ia2 Ic1 Ic2	Two core screened Screen = Earth
Local Stop Button (digital input)	19 20	SpDig + SpDig-	*Two core screened Screen = Earth
Lock Switch (Digital Input)	21 22	Lock+ Lock-	*Two core screened Screen = Earth
Reset Switch (Digital Input)	23 24	Reset+ Reset-	*Two core screened Screen = Earth
Start Switch (Digital Input)	25 26	Start+ Start-	*Two core screened Screen = Earth
Motor Contactor Aux Contact (Digital Input)	27 28	MCI+ MCI+	*Two core screened Screen = Earth

*The IPC's digital inputs could alternatively be run in a screened multicore cable. (Separate cable for each IPC Relay in multiple installations.)

Where these "low voltage" circuits need to connect near the power circuits (eg current transformers, cable connection module, main contactor auxiliaries etc), care needs to be taken to ensure that the circuits are adequately separated and restrained so that the separation is maintained, even if a wire termination comes loose etc.

(C) High Voltage Circuits

The "high" voltage circuits of the IPC Relay are the 110VAC supply (pins 30, 31) and the relay contacts. Apart from keeping these separate from the other wiring to the relay there are no special requirements.

In accordance with Australian Standards the relay contacts of the IPC Relay must not be used to switch more than 190VAC, 5A or 100VA; the intrinsic safety will be compromised if any of these values are exceeded.

(D) Earthing

The IPC has two earth connections. The earth pin 7 is for the intrinsically safe circuits (including the pilot circuit). The earth on pin 29 connects to the earth shield of the IPC Relay's internal transformer. The CCMA also has an earth connection, as this is effectively a diode barrier. Ideally, all of these should be run back separately to the main earth point. Note that AS2381.7 requires the earth cable to be a minimum of 4mm².

13. IPC Equipment Parts List

118783	Integrated Protection Relay IPC1V01
101504	IPB Remote Termination Unit RTU-2
101182	IPC Base Plate
101500	IPC Remote Display Module RDM-1K
119055	CCMC-415V Cable Connection Module
101490	CCMC-1000V Cable Connection Module
101491	CCMC-3.3kV Cable Connection Module
101487	110V Cable Connection Module
101503	IPA/IPB Relay/LED Output Module
101526	IPB Pilot Protection Fuse Holder
101296	IPB Pilot Protection Fuse Holder c/w 3A Fuse
117139	3A Fuse (Box of 10)
119051	IPC1V01 User Manual

14. IPC Specifications

Auxiliary Supply Volts:	110vac ± 10% 10VA, 50Hz ± 2 Hz
Earth Leakage Protection:	Trip Setting 100-500 mA in 50 mA increments Time Delay Instantaneous (<80mS), 150mS to 470mS in 40mS increments
Earth Continuity Protection:	Reset if resistance < 45 Ohms Trip if resistance > 45 Ohms Shunt Leakage Trip if < 1500 Ohms Operating Time 80, 120, 160, 200, 300, 400, 500mS
Pilot Cable Parameters:	C < 0.3µF, L < 10mH, L/R<600uH/Ω
Earth Fault Lockout Protection	
Lockout Resistance (IS Test):	415V < 4.15k Ohms 3.3kV < 33k Ohms 1000V < 10k Ohms Test Time 1 second
Lockout Resistance (Insulation Test):	Selectable at 0.1, 0.2, 0.5, 1, 2, 5, 10 and 15 MΩ and off Test Time 2 seconds
Alarm Settings:	Insulation Test Trip setting x 1.5
Overcurrent/Overload Protection	
Current Range:	7.5 to 464 Amps (60 to 116 Amps in 4 Amp increments, times current multiplier)
Current Multiplier:	1/8, 1/4, 1/2, 1, 2, 4 times
Time Multiplier:	0.005, 0.01, 0.015, 0.02, 0.03, 0.04, 0.05, 0.075, 0.1, 0.15, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 1.0 times
Cooling Multiplier:	0.2, 0.3, 0.4, 0.5, 0.8, 1.0, 2.0, 5.0, 10, 20, 50 times
Current Balance	
Trip Settings:	5%, 10%, 20%, 50% and off
Short Circuit Protection	
Trip Setting:	3.0 to 10.0 times in 0.5 increments (times full load current)
Trip Time:	20, 40, 60, 80, 100, 120, 160mSec
Back EMF Timer	
Trip Delay Settings:	2, 5, 10, 20 seconds
Machine Numbers:	Can be allocated from 1 to 40
Fan Current	
Threshold Level:	32% to 96% in 8% increments (% of full load current)
Undervoltage Protection:	Selectable from 20% to 80% in 10% increments Trip delay 800mSec
Serial Communications:	For information on Protocol and hardware requirements see DNET-IP2 Serial Communication System User Manual.
Relay Contacts:	MCR, CBR, RL3, RL4 1 N/0 5A/190VAC 100VA maximum 1 C/0 5A/190VAC 100VA maximum

15. Troubleshooting

If a problem is experienced with the relay, use the following tables to fault find the problem. Should the fault persist, remove the relay and return the relay, plus a description of the fault, to Ampcontrol for repairs.

Note: Checking the Status page (level 0, position 0) should be the first step in troubleshooting. This displays what the relay requires to make it operate. Also check the first six event logs.

Symptom	Cause	Remedy	Page
Remote Display shows a blank screen. The RDM Healthy LED indicator located on the top of the RDM module is off	Loss of power to the Display	Check there is power to the relay and it is correctly plugged in. The Relay supplies 15v dc to RDM. Check cable between RDM and the relay.	1
	Faulty Display Module.	Replace module.	
Remote Display shows a blank screen. The RDM Healthy LED flashes at 1 Hz.	Power to RDM is healthy but there is no data	Check data cable between the relay and the RDM.	1
Status Message: IPC Memory Error When in diode pilot mode	Corruption in the Group 1 or 2 Settings, stored in the IPC Relay	Examine the Group 1 and 2 Settings (level 8 and 9) to check the stored parameters in the non-volatile memory. Machine type and number are irrelevant and should be ignored. One or several settings will show '???'. Re-program lost settings into the memory.	7,8
Status Message: IPC Memory Error When in RTU pilot mode	Corruption in the Group 1 Settings in the IPC Relay	Examine the Group 1 Settings (level 8) to check the stored parameters in the non-volatile memory. One or several other settings will show '???'. Re-program lost settings into the memory.	7
Status Message: RTU Memory Error	Either the RTU is not on line or the RTU's non - volatile memory has been corrupted	Check that the RTU is on line (level 3, position 1) ie., a healthy pilot loop. If the RTU is on line examine the Group 2 Settings stored in the RTU (level 9). One or several other settings will show '???'. Re-program lost settings into the RTU memory.	8
Relay will not close. EC fault indicated.	Faulty pilot circuit (open or high resistance or shorted to earth)	Check pilot circuit eg., operate relay with a dummy plug if in diode mode. If still faulty replace the relay.	3
		Check pilot fuse	
Status Message: Need RTU Start or Stopped - RTU or Stopped - RTU PTC	Relay is waiting for the RTU digital inputs to be closed	Ensure all three RTU digital inputs are closed.	2

Symptom	Cause	Remedy	Page
Status Message: "Locked Out - Fan"	Relay is waiting for fan interlocking system.	If interlocking is not required then a 10k ohm resistor must be connected between terminals 9 and 12.	6
		If fan interlocking is used ensure that the fan is running and the current threshold setting in the fan outlet's RTU is correct. The Fan Outlet IPC should pick up its FID (Fan Interlock Drive) signal, which causes all other relays to pick up their FIR (Fan Interlock Read). Check these conditions level 6, position 4.	
		If fan interlocking is not correct check the wiring between the fan relay and other relays (terminal 9).	
Relay displays ' Outlet Close Fail' message after start is pressed.	The relay's MCI input is not closing within 5 Sec of MCR relay pickup (level 6 position 2).	Check that main contactor is closing. If not check circuit or replace main contactor. Check auxiliary contacts and wiring.	10
RDM displays 'Tripped-No Volts' message.	Relay not receiving/lost voltage feedback on one or all three outlet phases when contactor closed.	Check system voltage display (level 4, position 1) as contactor closes. Compare this with the under voltage threshold.	6
		Check continuity from the relay, through the CCMC to power conductors. This can be achieved by testing each phase to earth at the outlet, provided the circuit is isolated. Typical readings: CCMC-415 2340k ohm CCMC-1000 2340k ohm CCMC-3.3k 7520k ohm	17
Relay Trips on MCF on power up.	Main contactor fail condition.	Check main contactor for leakage across terminals on frozen contactor condition.	6
	Flat or faulty battery.	AA cell installed under the top cover requires replacement. A direct replacement as listed in the approval can be replaced by the owner in a workshop environment. It is recommended that the relay be returned to Ampcontrol for battery replacement and full testing.	11
Time and date incorrect. Resets to 1/01/9? on power up.	Low IS battery	AA cell installed under the top cover requires replacement. A direct replacement as listed in the approval can be replaced by the owner in a workshop environment. It is recommended that the relay be returned to Ampcontrol for battery replacement and full testing.	11

Earth Leakage Toroid :-
type AMPCONTROL EL 500.

E/L Test Resistor :-
R(eft) = 200 Ohms.
(needs to produce test current
of 100-160% of Trip Level.)

Cable Connection Module :-
IPB Mode
415V System : Ampcontrol CCMA-415
1000V System : Ampcontrol CCMA-1000
3.3kV System : Ampcontrol CCMA-3.3k
IPC Mode
415V System : Ampcontrol CCMC-415
1000V System : Ampcontrol CCMC-1k
3.3kV System : Ampcontrol CCMC-3.3k

Earth Fault Test Resistors :-
CCMA-415 : 91K Ohms, CCMC-415 : 2.4M Ohms
CCMA-1000 : 220K Ohms, CCMC-1K : 2.4M Ohms
CCMA-3.3k : 680K Ohms, CCMC-3k3 : 7.68M Ohms

Over Load CT's :-
1000/1, Class 2M,
STC Rating: 20kA - 3 Sec.

Note : Phasing on Overload C/T's Must be as Shown.

Maximum Short Time Rating of 16kA / 3 Sec, 20kA / 120 mSec Intrinsic Safety may be compromised if this level is exceeded !

Incoming Supply

A B C

Control Isolator

110Vac Control Supply

110Vac

MCR Stop CR

CR MC

CBR CB OTHER TRIPS

RL4 CCMC

Insulation Test

Control Transformer 110Vac Sec. to AS 3108.1 or AS 3126

CB (U/V)

Isolation Chamber

to other Outlets

43 44 45 46 47 48 49 50 51 52 53 54 55 56

MCR RL3 RL4 CBR

110Vac

Earth 29

0Vac 30

110Vac 31

Optional Led/Relay Module

Refer Dwg. IPAS005/2 06/01/92

RUN - MCF SC OC EFLO EC EL

OCO7 42 OCO6 41 OCO5 40 OCO4 39 OCO3 38 OCO2 37 OCO1 36 OCO0 35 OCO com 34

AMPCONTROL I.P.C.

Integrated Protection Relay, Type C

AMPCONTROL I.P.S.I.

Optional Serial Interface Module

Comms.

+Vsc 8 TXD 10 RDI 11 0V

FAN INTERLOCKING

To Other Fan Interlocked IPC Relays' FIO pins (Maximum of 10)

FIO 9

(fio) R 100 Ohm / 1W 2% (Only one for whole loop)

0V 12

If Interlocking is NOT required, use a 10K/1W/2% on each FIO pin, & DO NOT interlink Relays.

Data 13 +Vdm 14

19 Stop+ Stop 20 Stop-

21 Lock+ Lock 22 Lock-

23 Reset+ Reset 24 Reset-

25 Start+ Start 26 Start-

27 MCI+ MCI 28 MCI-

MC

1 EL1 2 EL2

R(elt) EVLS Testo 110V ac

15 Ia1 16 Ia2 S1 P1 S2 P2

17 Ic1 18 Ic2 S1 P1 S2 P2

Cables passing through toroid & C/t's to be Insulated to System Volatge Level

3 Vcma 4 Vcmb 5 Vcmc

110V com RL4

Ampcontrol CCMC Cable Connection Module

A B C

R(eft) EF TEST

Earth

7 Earth 6 Pilot

EC Test

Fuse 5Amp Max.

Safe Area

Hazardous Zone

A B C

Trailing Cable

FLP Enclosure

FLP Enclosure

M 3~

Sheilded 2 Core Cable

AMPCONTROL RDM1

Ex ia I T4

ENT

EL EC EF OC SC MCF Run

I.S. Remote Display Module

Ampcontrol RTU-2

Rx Tx 0v Start Stop PTC RTDcom RTD1 RTD2 RTD3 RTD4

Remote Termination Unit

Ex (ia) I

PT100 RTD's

PT-100 RTD's

Emergency Stop

Pilot Earth

IPC Diode Mode Pilot Connections

Stop Start

Pilot 100 Ohm Earth

Remote Control

Pilot Earth

Local Control

AMPCONTROL DWG No: IPC – E – 001

SHEET A3

REV 0

IPC
INTEGRATED PROTECTION RELAY
TYPICAL CONNECTION DIAGRAM

	NAME	DATE
DRAWN:	D.P.	26/2/01
CHECKED:		
APPROVED:		
SCALE		NTS

AMPCONTROL PTY. LTD.
A.C.N. 009 779 141
HEAD OFFICE - NEWCASTLE
250 MACQUARIE ROAD, WARNERS BAY, NEWCASTLE, AUSTRALIA
Ph:(049) 56 5899
FAX:(049) 56 5985

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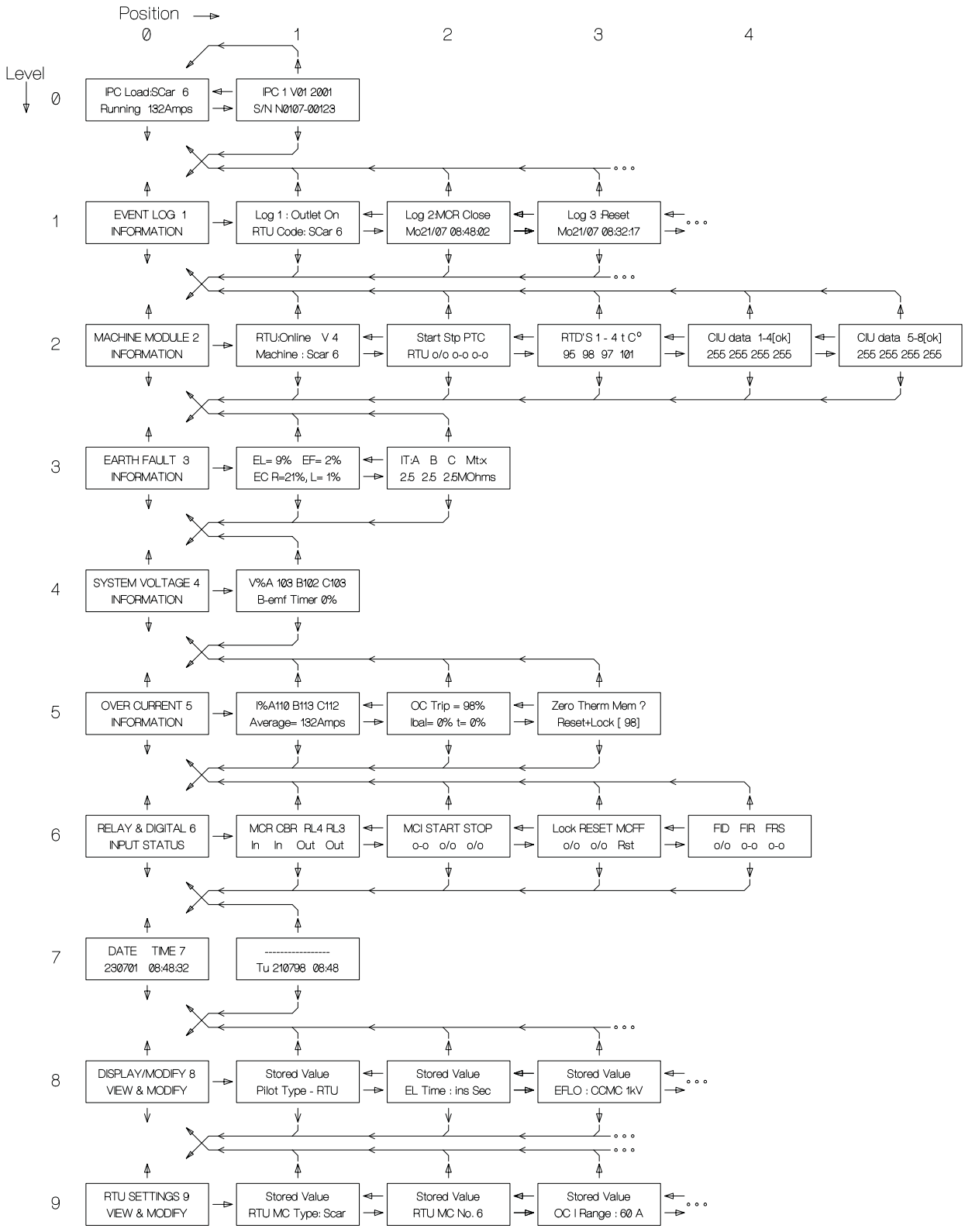
REVISION 0 ORN 4564 20/06/00



AMPCONTROL DWG No: IPC – B – 002

SHEET A3

REV 0

IPC Relay
Integrated Protection Relay
Display Map
(Version IPC1 V01)

	NAME	DATE
DRAWN:	D.P.	23/07/01
CHECKED:		
APPROVED:		
SCALE		NTS

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ACN 000 770 141
HEAD OFFICE - NEWCASTLE
250 MACQUARIE ROAD, WARNERS BAY,
NEWCASTLE, AUSTRALIA
Ph:(049) 56 5899
FAX:(049) 56 5985

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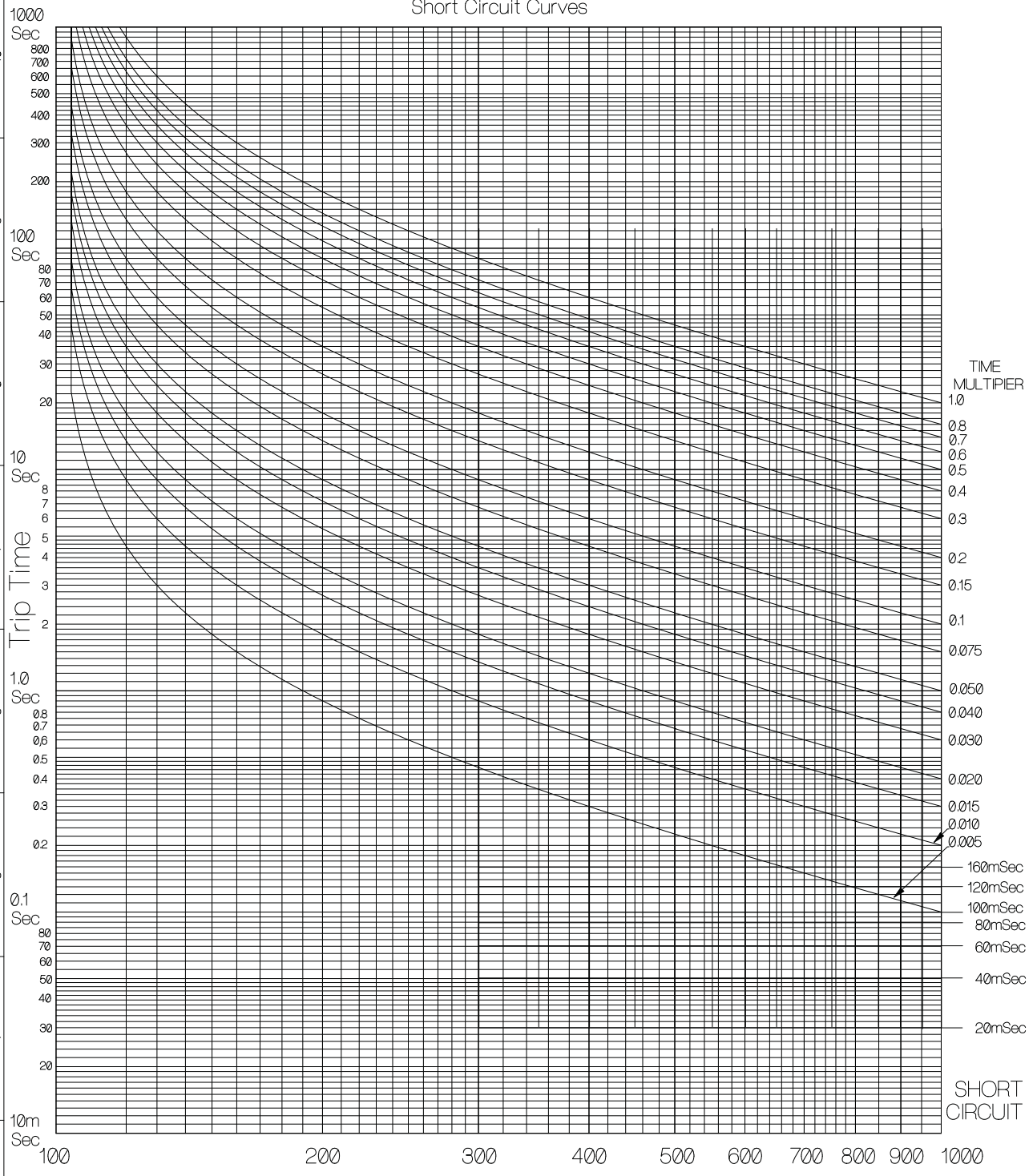
20/06/00

IPC1 Very Inverse Over Current & Short Circuit Curves



Selected Full Load Current (SFLC)						
Cur Range	Cur Mul					
	1/8*	1/4*	1/2*	1.0*	2.0*	4.0*
60A	7.5A	15A	30A	60A	120A	240A
64A	8 A	16A	32A	64A	128A	256A
68A	8.5A	17A	34A	68A	136A	272A
72A	9 A	18A	36A	72A	144A	288A
76A	9.5A	19A	38A	76A	152A	304A
80A	10 A	20A	40A	80A	160A	320A
84A	10.5A	21A	42A	84A	168A	336A
88A	11 A	22A	44A	88A	176A	352A
92A	11.5A	23A	46A	92A	184A	368A
96A	12 A	24A	48A	96A	192A	364A
100A	12.5A	25A	50A	100A	200A	400A
104A	13 A	26A	52A	104A	208A	416A
108A	13.5A	27A	54A	108A	216A	432A
112A	14 A	28A	56A	112A	224A	448A
116A	14.5A	29A	58A	116A	232A	464A

Over Current Trip time :-

$$t(sec) = \frac{180 * m}{(I - 1)}$$

m = time Multiplier

$$I = \frac{\text{Fault Current}}{\text{Selected Full Load Current}}$$

Short Circuit Selectable at -

3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5,
7.0, 7.5, 8.0, 8.5, 9.0, 9.5, 10.0
Times Selected Full Load Current

Times Selectable at 20, 40, 60, 80,
100, 120 & 160 mSec.

AMPCONTROL DWG No: IPC – B – 004
SHEET A3
REV 0

IPC1V02
Over Current & Short Circuit Curves
VERY INVERSE CURVE

	NAME	DATE
DRAWN:	G.R.	26/05/03
CHECKED:		
APPROVED:		
SCALE		NTS

AMPCONTROL PTY. LTD.
ACN 000 770 141
HEAD OFFICE - NEWCASTLE
250 MACQUARIE ROAD, WARNERS BAY,
NEWCASTLE, AUSTRALIA
PH:(0049) 56 5999
FAX:(0049) 56 5995

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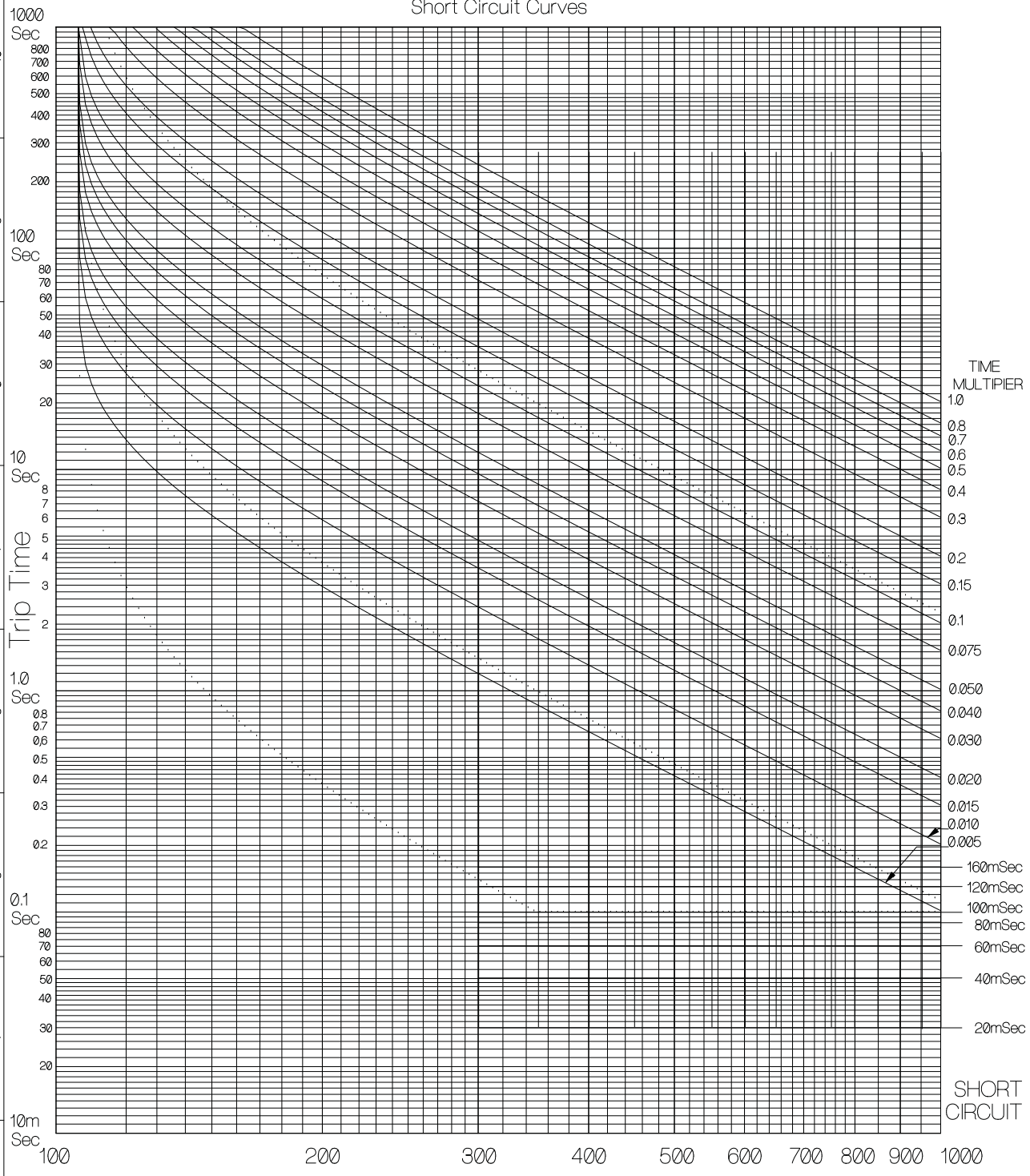
0.CRN 4966 26/06/03

IPC1 Motor Overload & Short Circuit Curves



Selected Full Load Current (SFLC)						
Cur Range	Cur Mul					
	1/8*	1/4*	1/2*	1.0*	2.0*	4.0*
60A	7.5A	15A	30A	60A	120A	240A
64A	8 A	16A	32A	64A	128A	256A
68A	8.5A	17A	34A	68A	136A	272A
72A	9 A	18A	36A	72A	144A	288A
76A	9.5A	19A	38A	76A	152A	304A
80A	10 A	20A	40A	80A	160A	320A
84A	10.5A	21A	42A	84A	168A	336A
88A	11 A	22A	44A	88A	176A	352A
92A	11.5A	23A	46A	92A	184A	368A
96A	12 A	24A	48A	96A	192A	364A
100A	12.5A	25A	50A	100A	200A	400A
104A	13 A	26A	52A	104A	208A	416A
108A	13.5A	27A	54A	108A	216A	432A
112A	14 A	28A	56A	112A	224A	448A
116A	14.5A	29A	58A	116A	232A	464A

..... Shows 'Hot' Curve for 1.0, 0.05 & 0.005 Multipliers

$$\text{M-O\L Trip Time} = 1800 \times m \times \ln\left(\frac{I^2 - h}{I^2 - 1.1238}\right) \text{Sec.}$$

m = time Multiplier
h = 0 for 'Cold', h = 1 for 'Hot'.
Min. O\L Trip time = 100mS.

Short Circuit Selectable at -

3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5,
7.0, 7.5, 8.0, 8.5, 9.0, 9.5, 10.0
Times Selected Full Load Current

S\C Trip Times Selectable at 20, 40, 60, 80, 100, 120 & 160 mSec.

AMPCONTROL DWG No: IPC – B – 005
SHEET A3
REV 0

IPC1V02
Motor Overload & Short Circuit Curves

	NAME	DATE
DRAWN:	G.R.	26/05/03
CHECKED:		
APPROVED:		
SCALE		NTS

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ACN 000 915 542
HEAD OFFICE - NEWCASTLE
250 MACQUARIE ROAD, WARNERS BAY,
NEWCASTLE, AUSTRALIA
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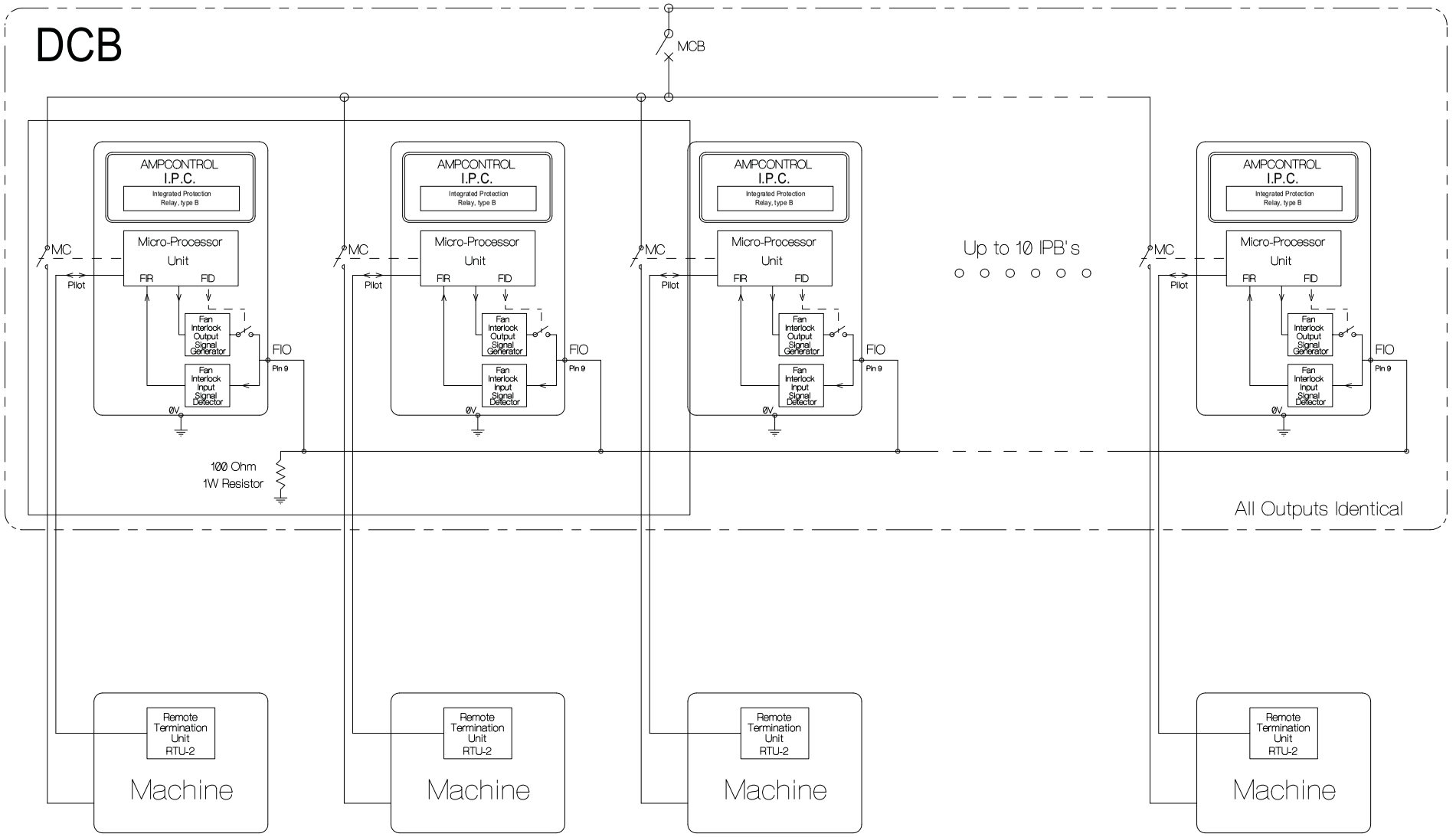
CRN 4956
26/06/03



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0.CRN 4956	
26/05/03	

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ACN 000 915 542
HEAD OFFICE - NEWCASTLE
250 MACQUARIE ROAD, WARNERS BAY,
NEWCASTLE, AUSTRALIA
Ph:(049) 56 5899
FAX:(049) 56 5985

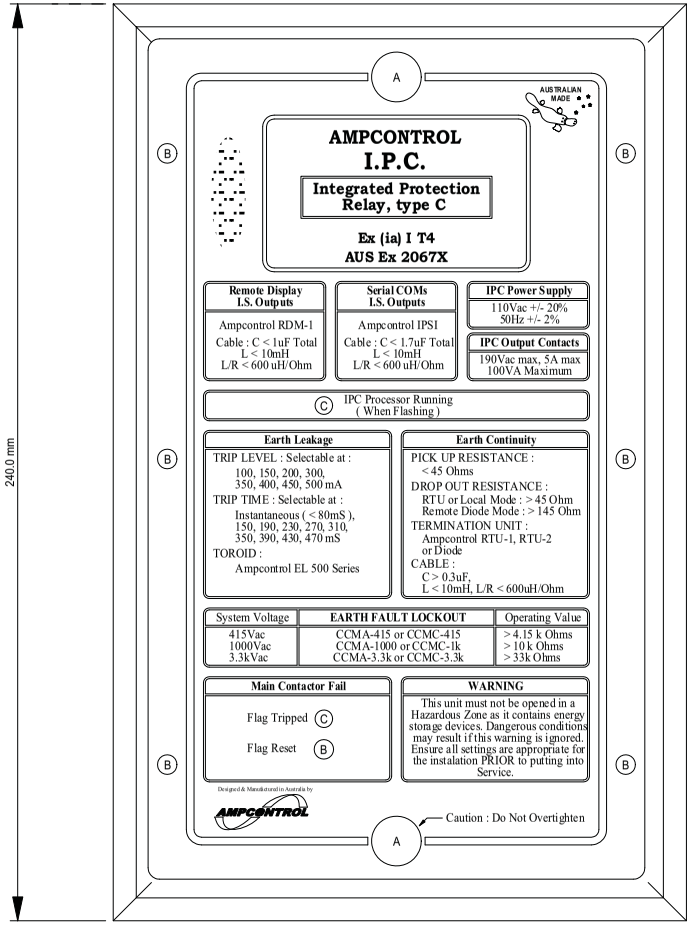
	NAME	DATE
DRAWN:	G.R.	26/05/03
CHECKED:		
APPROVED:		
SCALE	1=1	

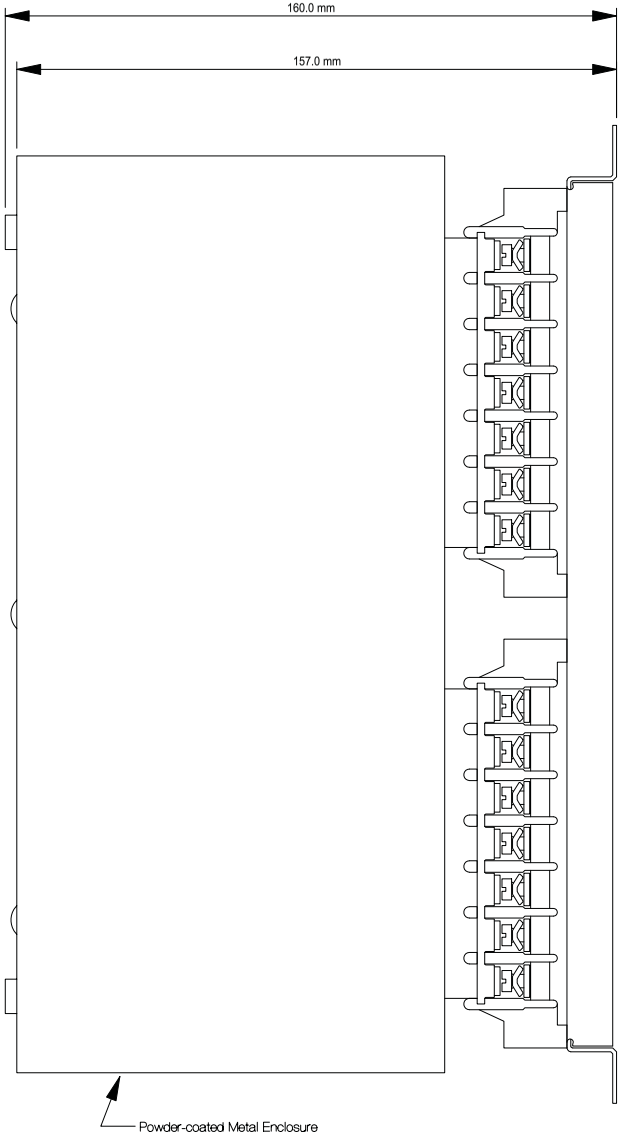
IPC
Fan Interlocking System

AMPCONTROL DWG No: IPC – B – 003

REV: 0

SHEET: A3





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0	CRN 4564	20/06/00

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ACN 000 915 542
HEAD OFFICE - NEWCASTLE
250 MACQUARIE ROAD, WARNERS BAY,
NEWCASTLE, AUSTRALIA
Ph:(049) 56 5899
FAX:(049) 56 5985

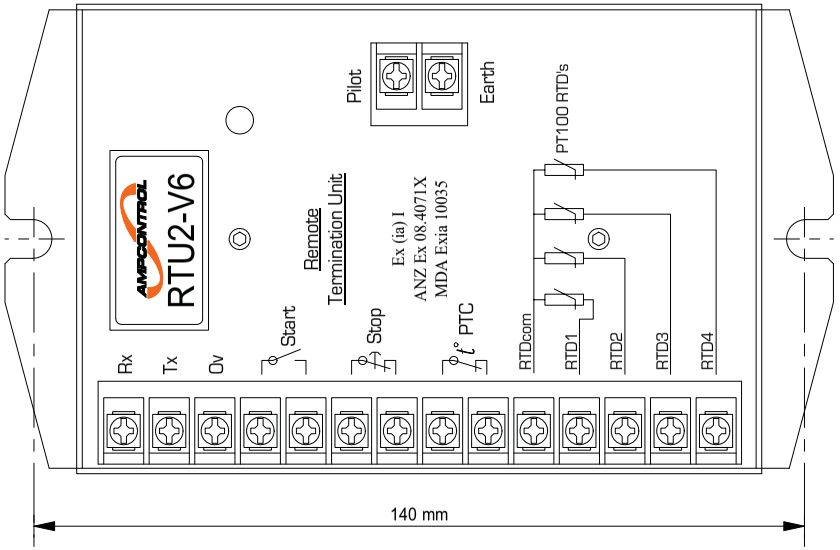
	NAME:	DATE:
DRAWN:	G.R.	2/8/01
CHECKED:		
APPROVED:		
SCALE:	1=1	

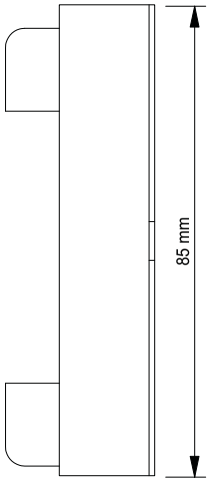
IPC RELAY
INTEGRATED PROTECTION RELAY ENCLOSURE DIMENSIONS

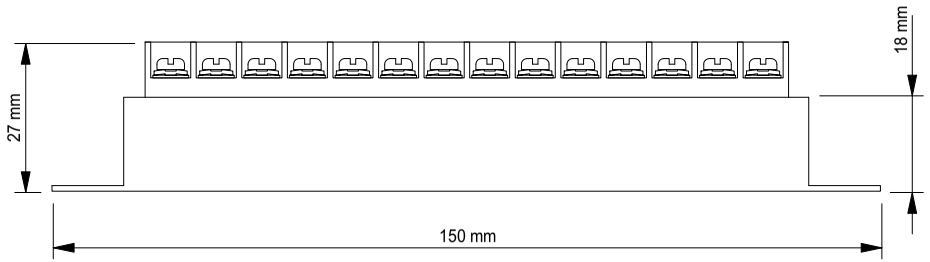
AMPCONTROL DWG No: IPC –M – 013

REV: 0

SHEET: A2







REVISION		
0.CRN 3963	04/04/97	
1.CRN 7066	22/09/08	

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AMPCONTROL CSM PTY. LTD.
ABN 35 000 770 141
7 BILLBROOKE CLOSE,
CAMERON PARK,
N.S.W. 2285, AUSTRALIA
P: +61 2 4903 4800
electronics@ampcontrol.com.au

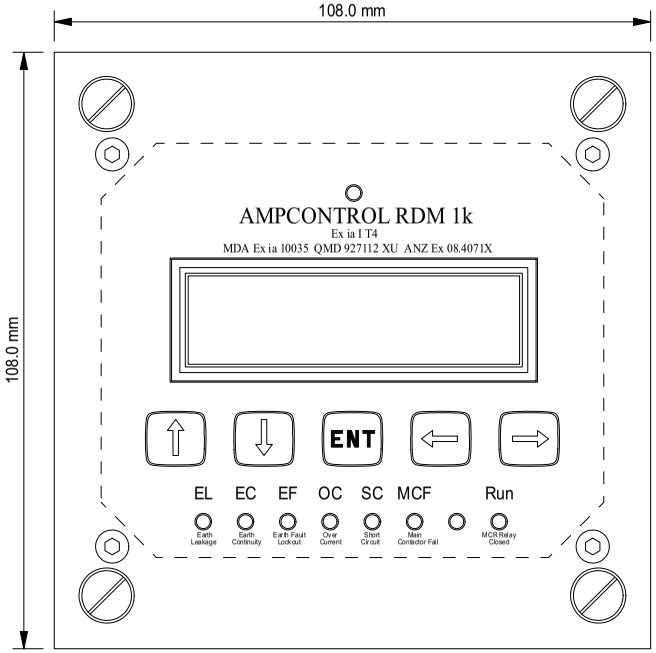
	NAME	DATE
DRAWN:	D.P.	16/07/97
CHECKED:	E.C.	12/01/09
APPROVED:	R.B.	21/01/09
SCALE	1:1	

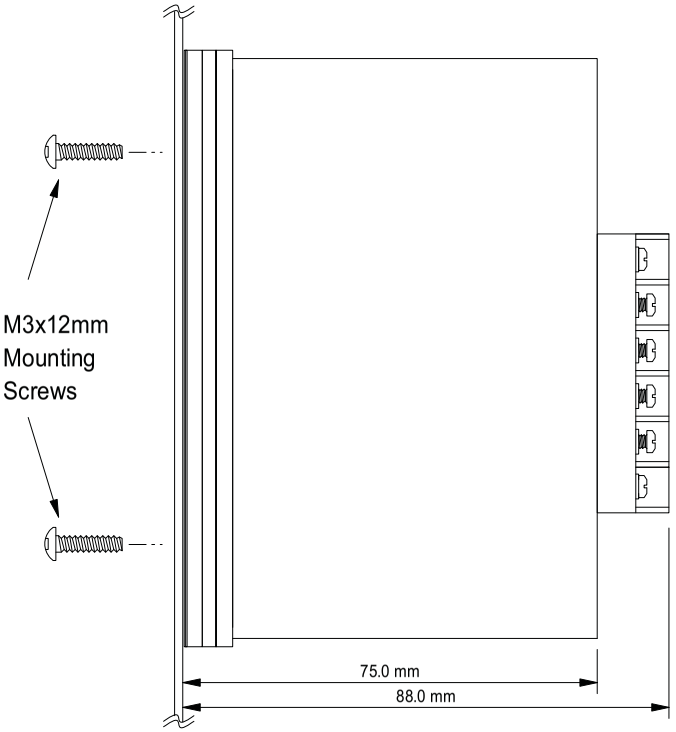
RYU_2
IPB REMOTE TERMINATION UNIT
GENERAL ARRANGEMENT

AMPCONTROL DWG No: IPB -A-021

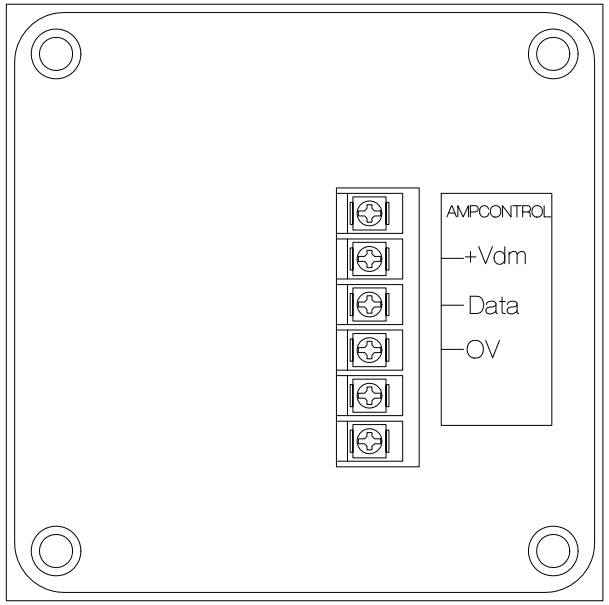
REV 1

SHEET A3

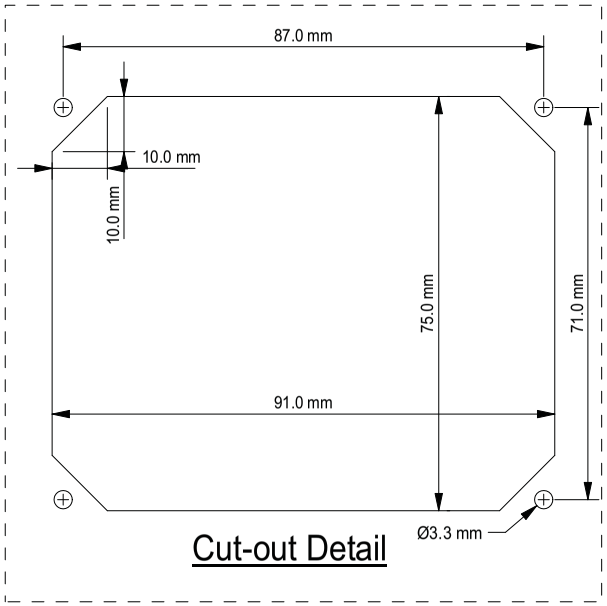




Side View Showing mounting into Enclosure Cut-out



Rear View



Cut-out Detail

Note:

1. RDM-1k to be mounted into cut-out of Enclosure to maintain at least IP54.

REVISION		
0.CRN 4210	26/04/98	
1.CRN 7066	22/09/08	

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AS1100
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AMPCONTROL CSM PTY. LTD.
ABN 35 000 770 141
7 BILLBROOKE CLOSE,
CAMERON PARK,
N.S.W. 2285, AUSTRALIA
P: +61 2 4903 4800
electronics@ampcontrol.com.au

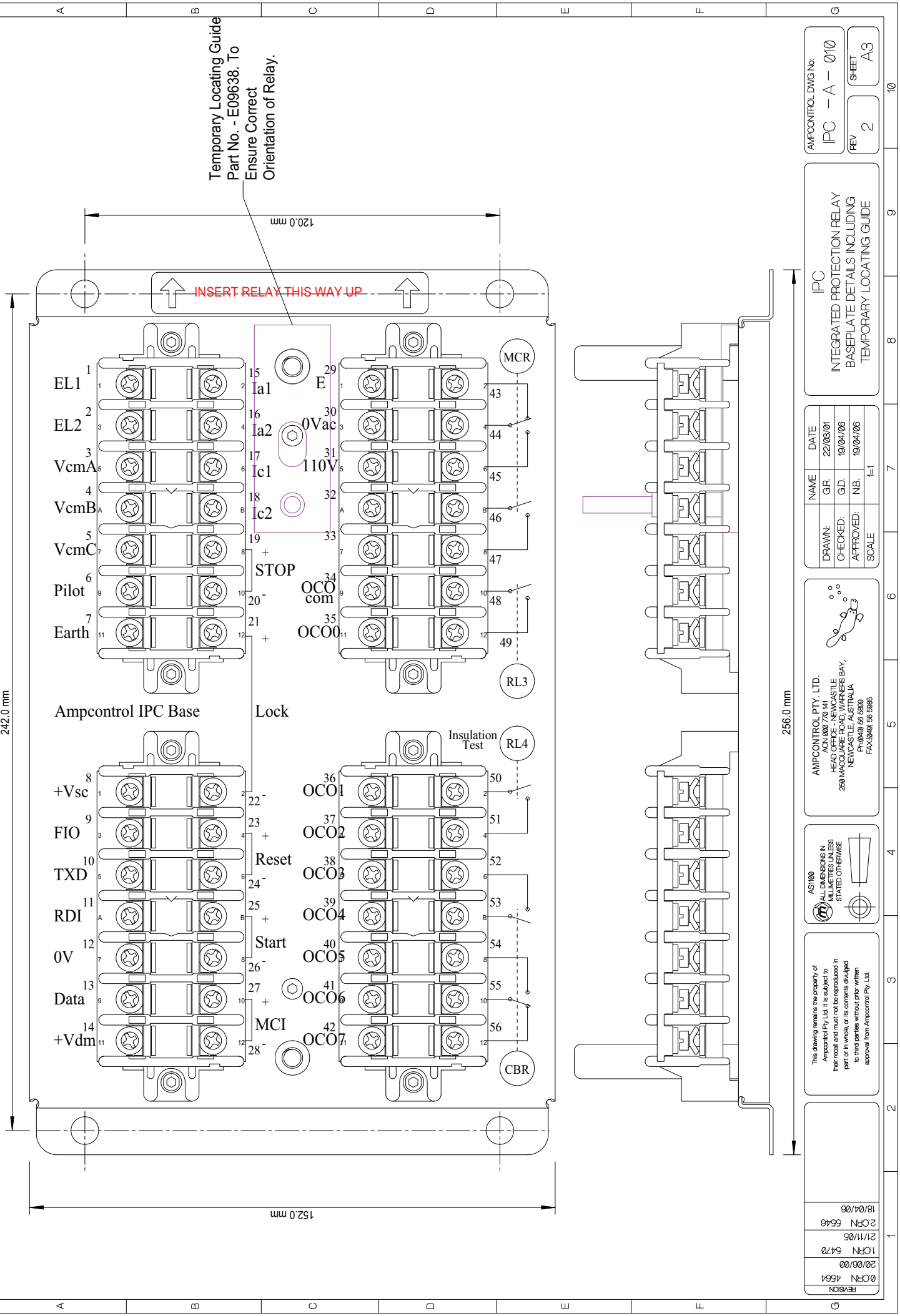
	NAME	DATE
DRAWN:	D.P.	03/08/98
CHECKED:	E.C.	12/01/09
APPROVED:	R.B.	21/01/09
SCALE	1:1	

RDM-1k
REMOTE DISPLAY MODULE
GENERAL ARRANGEMENT & MOUNTING DETAILS

AMPCONTROL DWG No: IPB -B-010

REV 1

SHEET A3


Temporary Locating Guide
Part No. - E09638. To
Ensure Correct
Orientation of Relay.
120.0 mm
INSERT RELAY THIS WAY UP
EL1
EL2
VcmA
VcmB
VcmC
Pilot
Earth
Ia1
Ia2
Ic1
Ic2
STOP
Lock
E
0Vac
110V
OCO com
OCO0
MCR
RL3
Ampcontrol IPC Base
+Vsc
FIO
TXD
RDI
0V
Data
+Vdm
Reset
Start
MCI
OCO1
OCO2
OCO3
OCO4
OCO5
OCO6
OCO7
Insulation Test
RL4
CBR
242.0 mm
256.0 mm
152.0 mm
AMPCONTROL DWG No: IPC – A – 010
SHEET A3
REV 2
IPC
INTEGRATED PROTECTION RELAY
BASEPLATE DETAILS INCLUDING
TEMPORARY LOCATING GUIDE
NAME DATE
DRAWN: G.R. 22/03/01
CHECKED: G.D. 19/04/06
APPROVED: N.B. 19/04/06
SCALE 1=1
AMPCONTROL PTY. LTD.
ACN 000 770 141
HEAD OFFICE - NEWCASTLE
250 MACQUARIE ROAD, WARNERS BAY,
NEWCASTLE, AUSTRALIA
Ph:(049) 56 5899
FAX:(049) 56 5985
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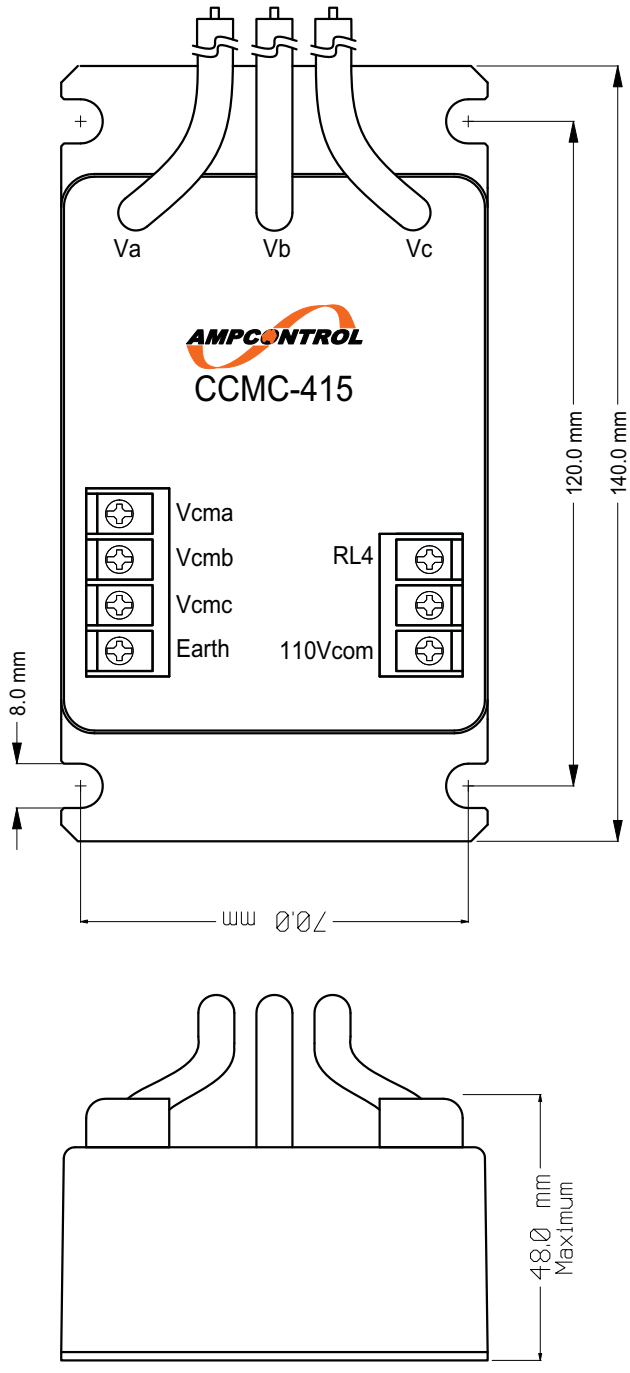
REVISION
0.CRN 4564 20/06/00
1.CRN 5470 21/11/06
2.CRN 5546 18/04/06



AMPCONTROL DWG No: IPC – A – 013
REV 0
SHEET A3

IPC
INTEGRATED PROTECTION RELAY
CCMC 415V
DIMENSION & MARKING DETAILS

	NAME	DATE
DRAWN:	D.P.	26/2/01
CHECKED:		
APPROVED:		
SCALE	1=1	

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ACN 000 778 141
HEAD OFFICE - NEWCASTLE
250 MACQUARIE ROAD, WARNERS BAY,
NEWCASTLE, AUSTRALIA
Ph:(049) 56 5899
FAX:(049) 56 5985

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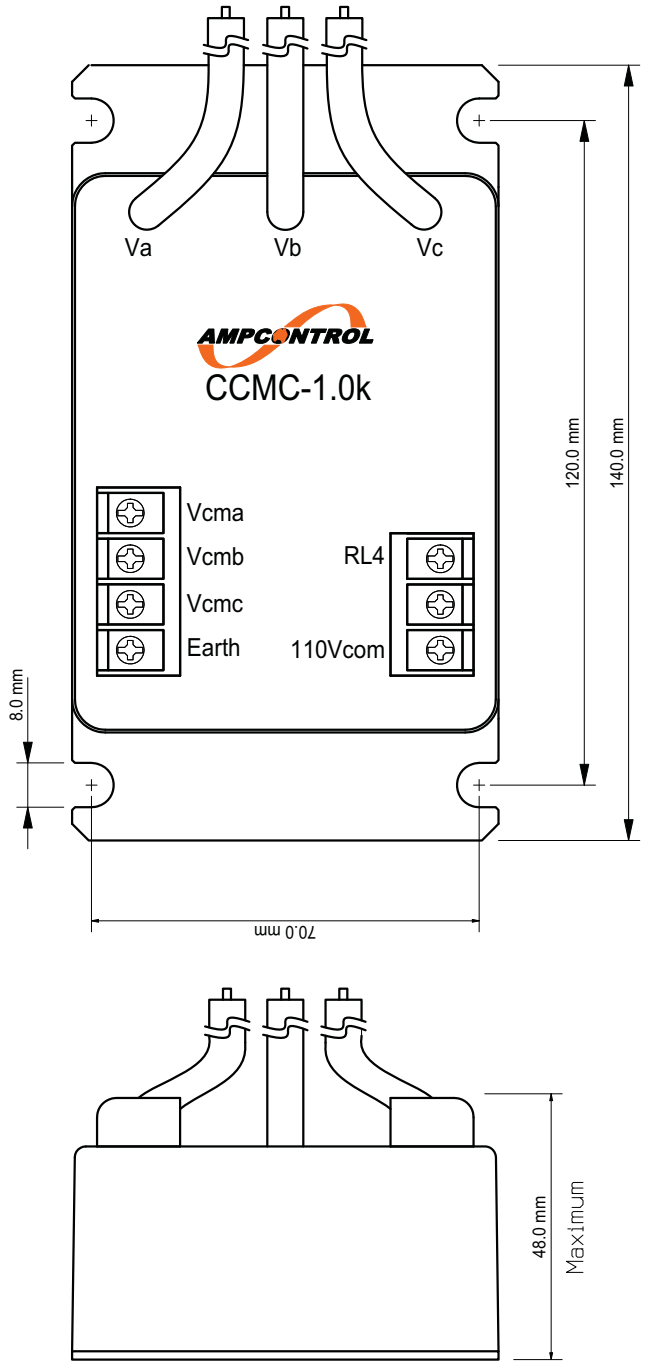
REVISION
0 CRN 4564
20/06/00



AMPCONTROL DWG No: IPC – A – 005
REV 0
SHEET A3

IPC
INTEGRATED PROTECTION RELAY
CCMC 1kV
DIMENSION & MARKING DETAILS

	NAME	DATE
DRAWN:	D.P.	5/6/00
CHECKED:		
APPROVED:		
SCALE	1=1	

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ACN 000 770 141
HEAD OFFICE - NEWCASTLE
250 MACQUARIE ROAD, WARNERS BAY,
NEWCASTLE, AUSTRALIA
Ph:(049) 56 5899
FAX:(049) 56 5985

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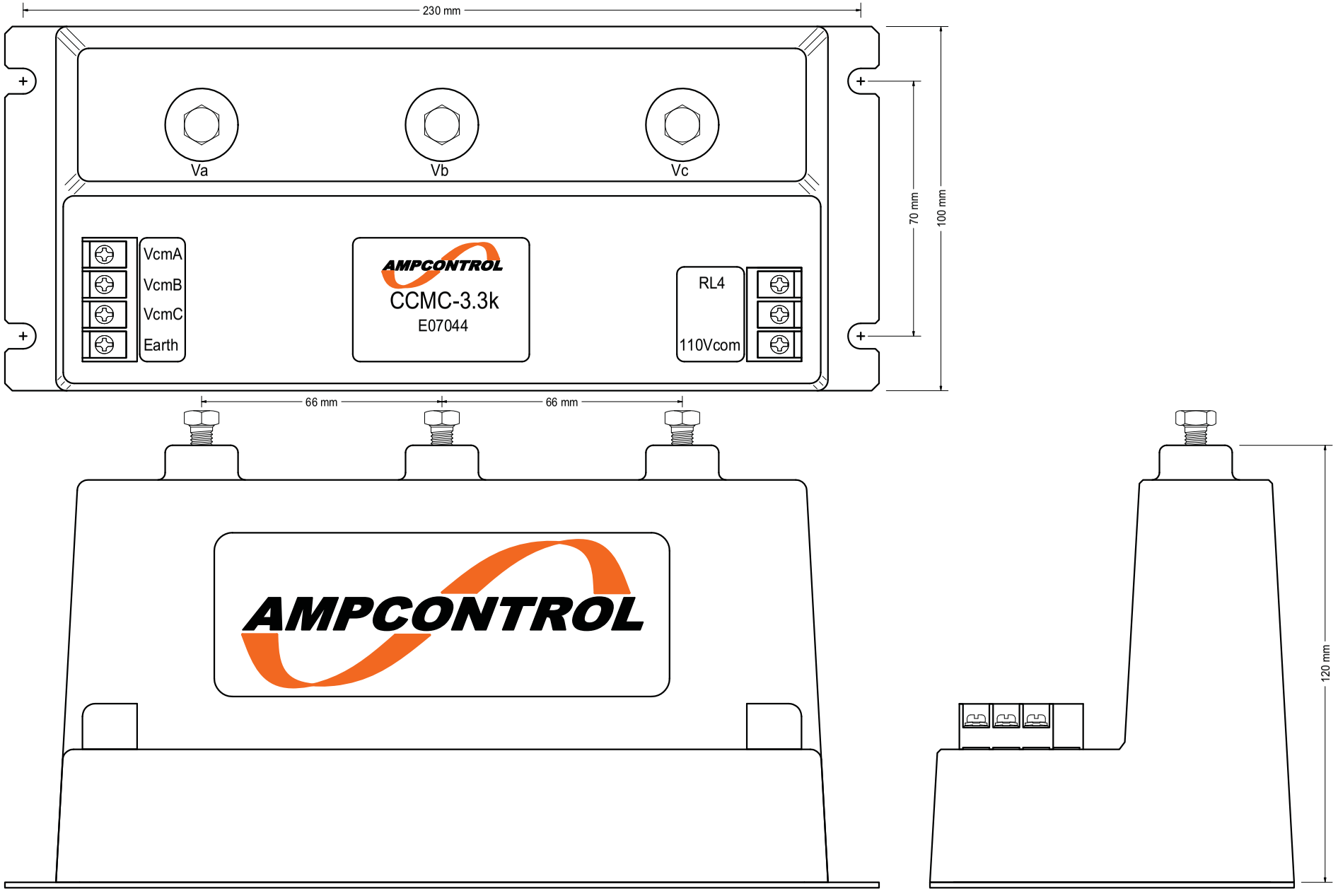
REVISION
0.CRN 4564
20/06/00



REVISION
0.CRN 4564
20/06/00

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ACN 000 770 141
HEAD OFFICE - NEWCASTLE
250 MACQUARIE ROAD, WARNERS BAY,
NEWCASTLE, AUSTRALIA
Ph:(049) 56 5899
FAX:(049) 56 5985

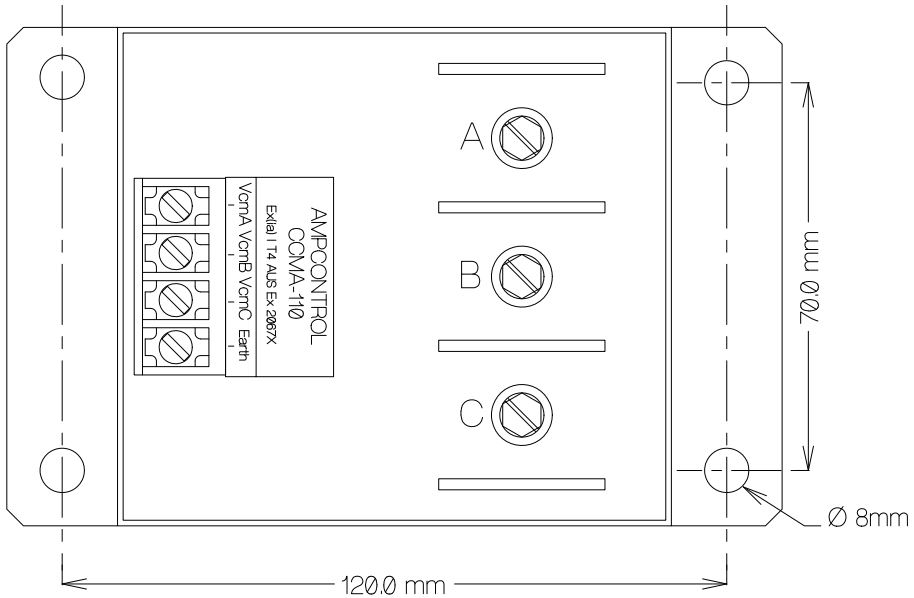
	NAME	DATE
DRAWN:	D.P.	20/03/01
CHECKED:		
APPROVED:		
SCALE	1=1	

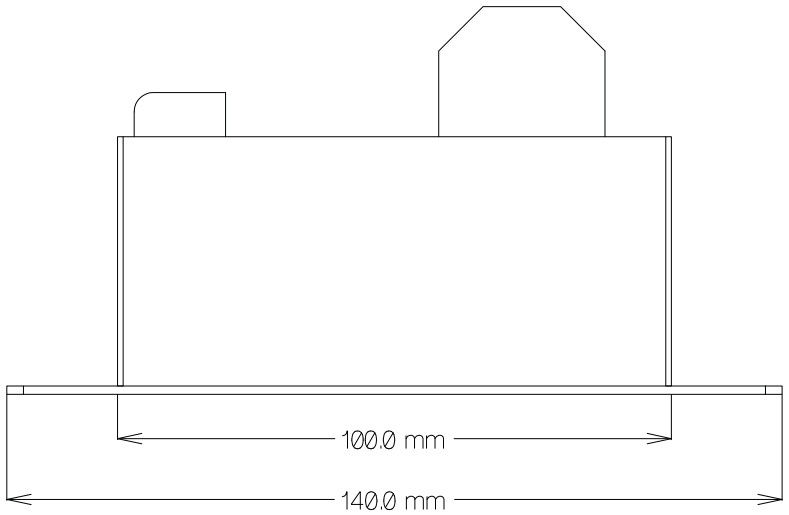
IPC
INTEGRATED PROTECTION RELAY
CCMC 3.3kV
DIMENSION & MARKING DETAILS

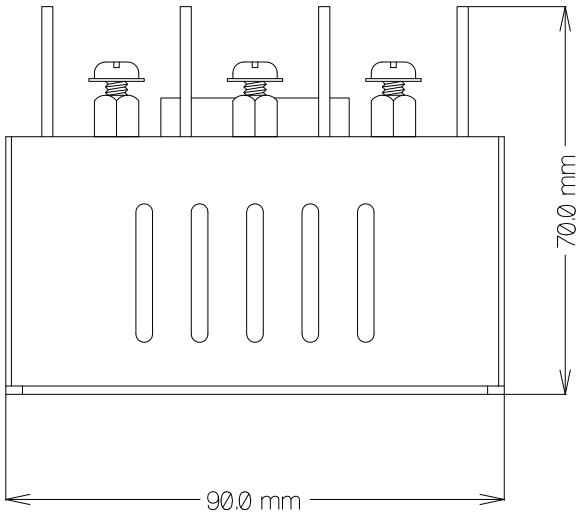
AMPCONTROL DWG No: IPC – A – 008

REV: 0

SHEET: A3







REVISION	
0.CRN 3463 27/6/95	

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ACN 000 770 141
HEAD OFFICE - NEWCASTLE
250 MACQUARIE ROAD, WARNERS BAY,
NEWCASTLE, AUSTRALIA
Ph:(049) 56 5899
FAX:(049) 56 5985

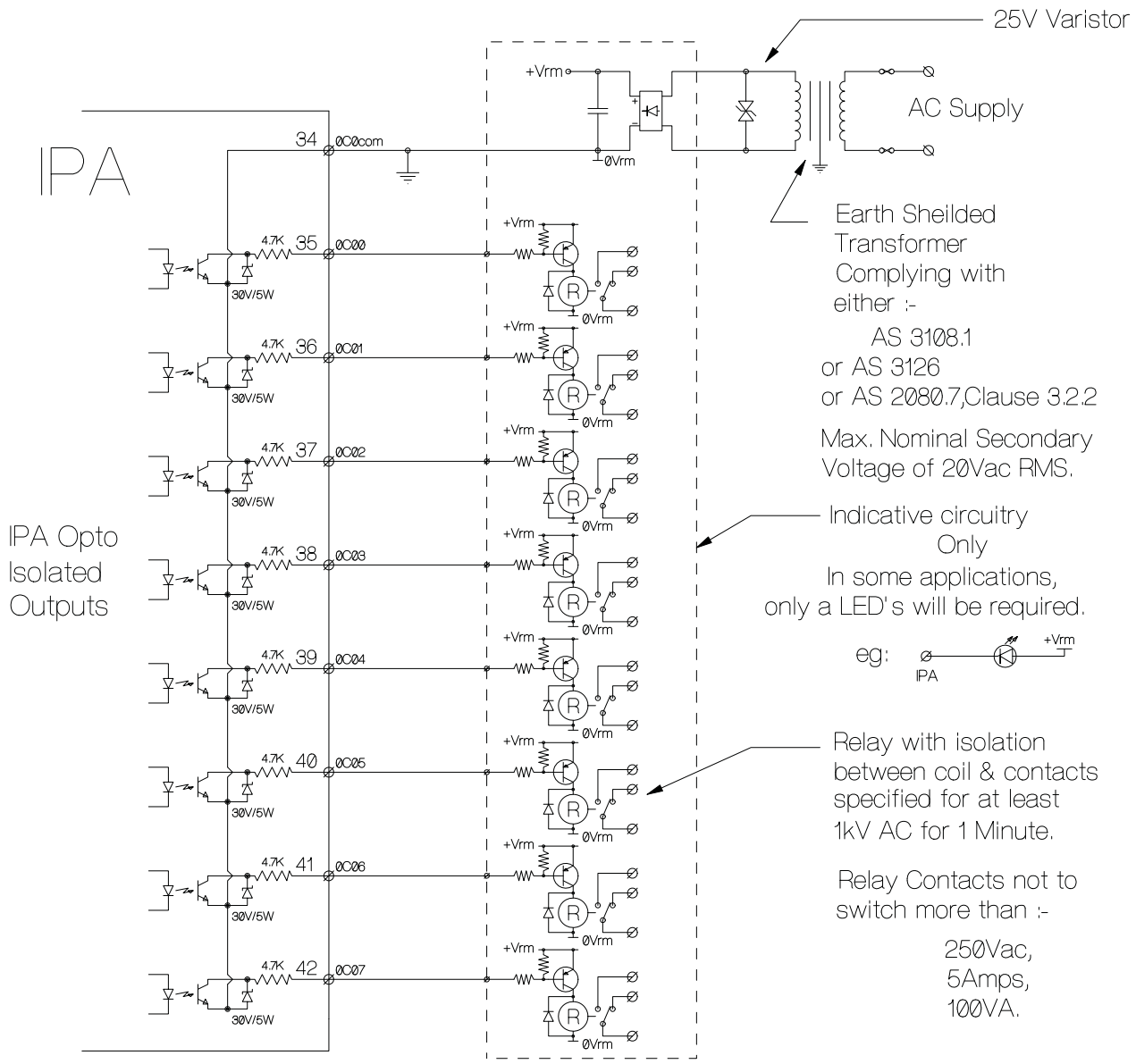
	NAME	DATE
DRAWN:	G.R.	30/06/95
CHECKED:		
APPROVED:		
SCALE	1=1	

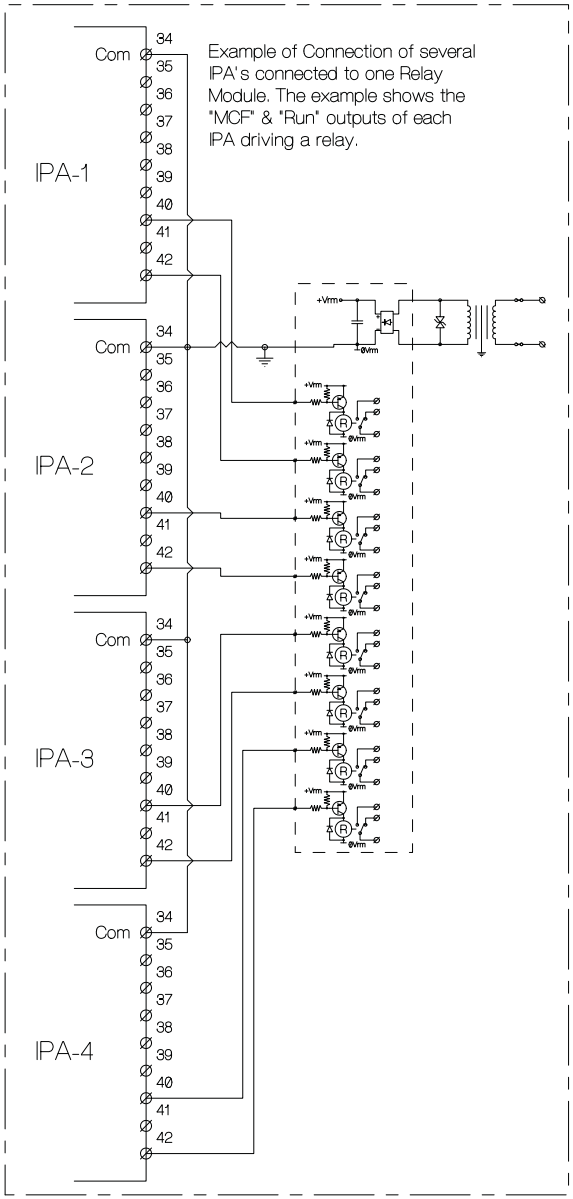
IPA 110V LINE
CONNECTION MODULE
DIMENSION & MARKING

AMPCONTROL DWG No: IPA -A- 033

REV 0

SHEET A3





Note : Some applications require several IPA's to drive one relay module - see example shown.

REVISION	
0.CRN	N/A

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ABN 35 000 770 141
7 BILLBROOKE CLOSE,
CAMERON PARK,
N.S.W. 2285, AUSTRALIA
P: +61 2 4903 4800
electronics@ampcontrol.com.au

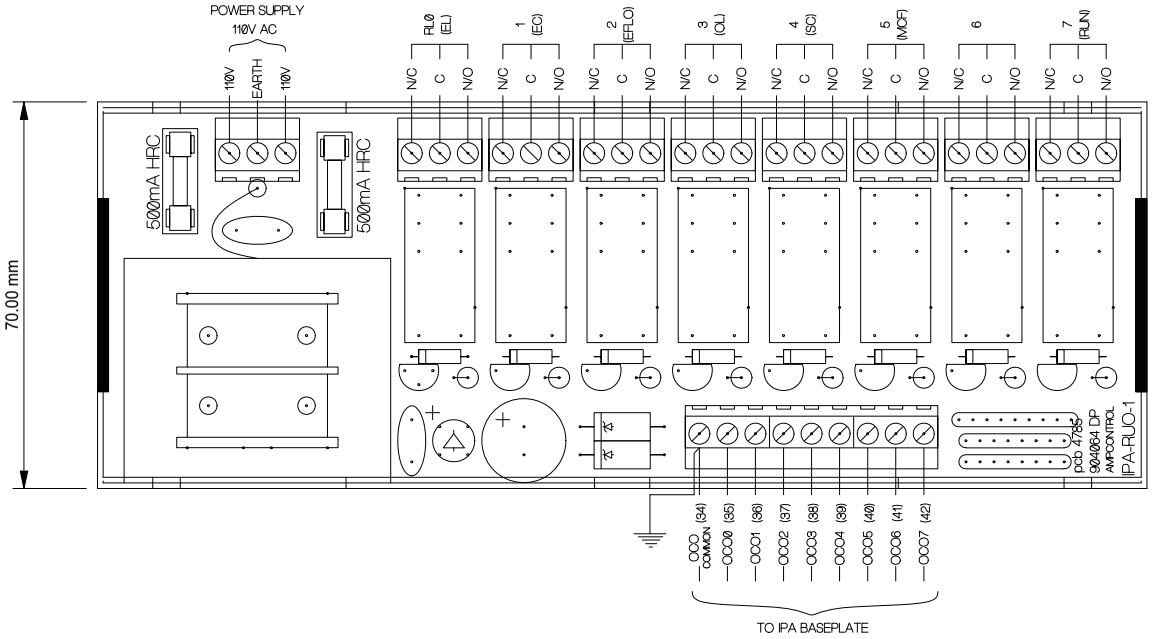
	NAME	DATE
DRAWN:	D.P.	06/01/92
CHECKED:		
APPROVED:		
SCALE	Nil	

IPA
RELAY/LED OUTPUT MODULE DETAILS

AMPCONTROL DWG No: IPA -S-005

REV 0

SHEET A3

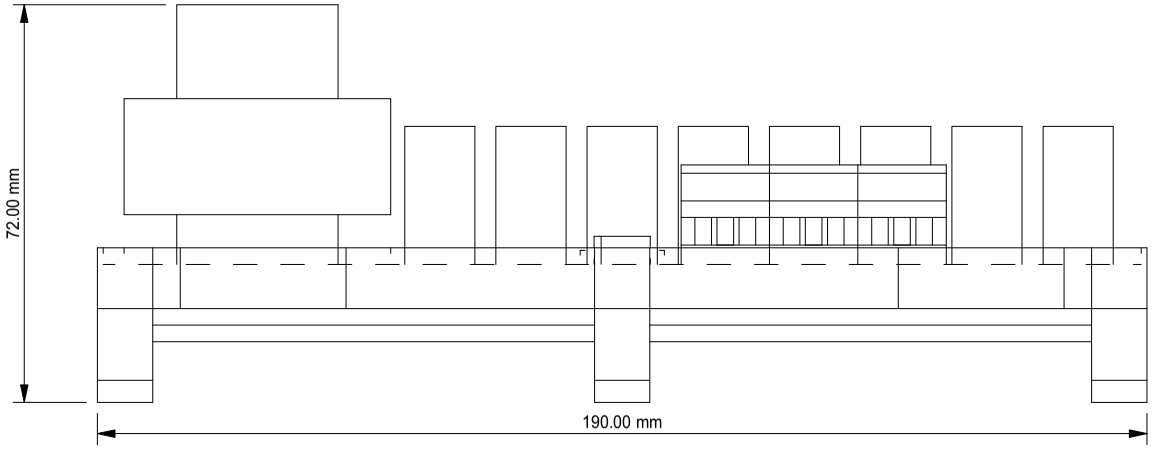


TOP VIEW OF PCB & HOLDER

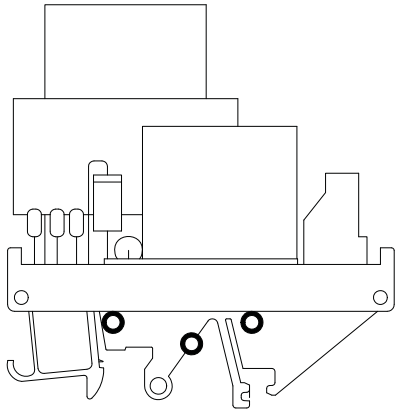
NOTES

1. MOUNT RELAY OUTPUT UNIT ON TS35 DIN RAIL.
2. TERMINAL No's 34 TO 42 ARE DIRECTLY WIRED TO BASES ON IPA BASEPLATE.
   EXAMPLE OF WIRING TO IPA - OCO0 (35).OCO0 INDICATES FUNCTION,35 INDICATES BASE PIN No.
3. RELAY CONTACTS MAX. 190V ac RMS
   190V DC
   3 AMPS

REFER TO MDA APPROVAL DRAWING
IPAS005/2 6/1/92



SIDE VIEW OF PCB & HOLDER



END VIEW

REVISION	
0.CRN 3133	20/5/94

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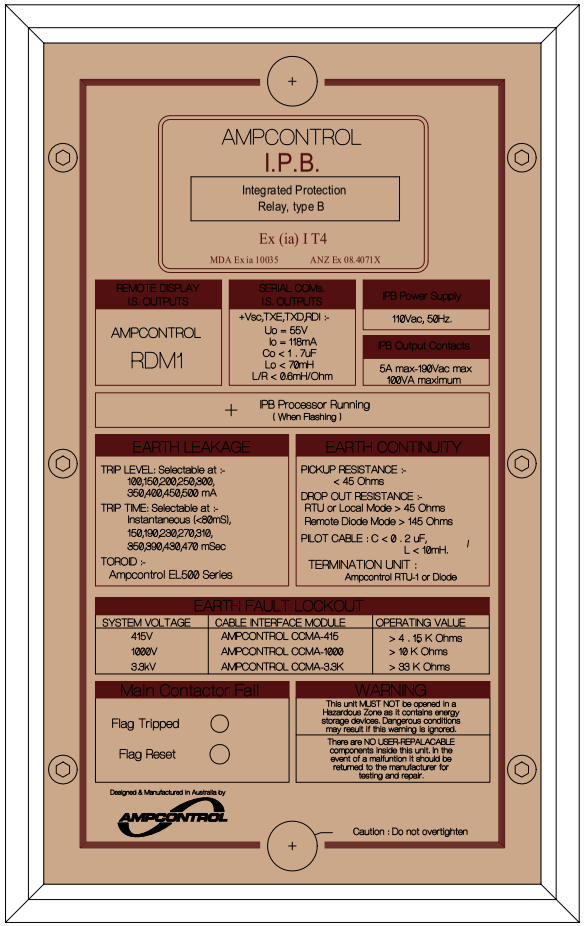
ABN 35 000 770 141
7 BILLBROOKE CLOSE,
CAMERON PARK,
N.S.W. 2285, AUSTRALIA
P: +61 2 4903 4800
electronics@ampcontrol.com.au

	NAME	DATE
DRAWN:	G.R.	20/5/94
CHECKED:		
APPROVED:		
SCALE	1=1	

IPA
RELAY OUTPUT UNIT
PCB & CARD HOLDER
GENERAL ARRANGEMENT

AMPCONTROL DWG No: IPA -A-031
REV 0
SHEET A3

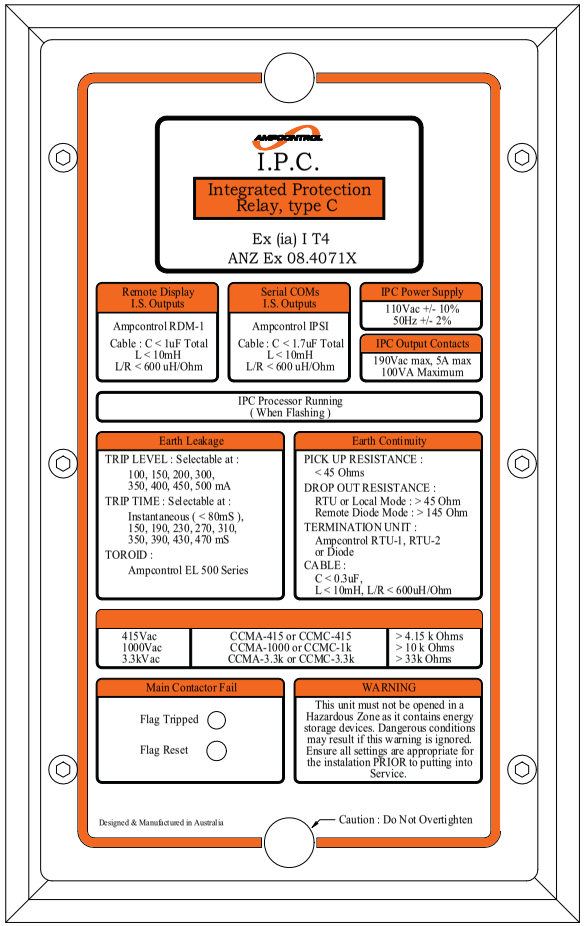
TOP



IPB RELAY

(POWDER COATED 'DOESKIN'

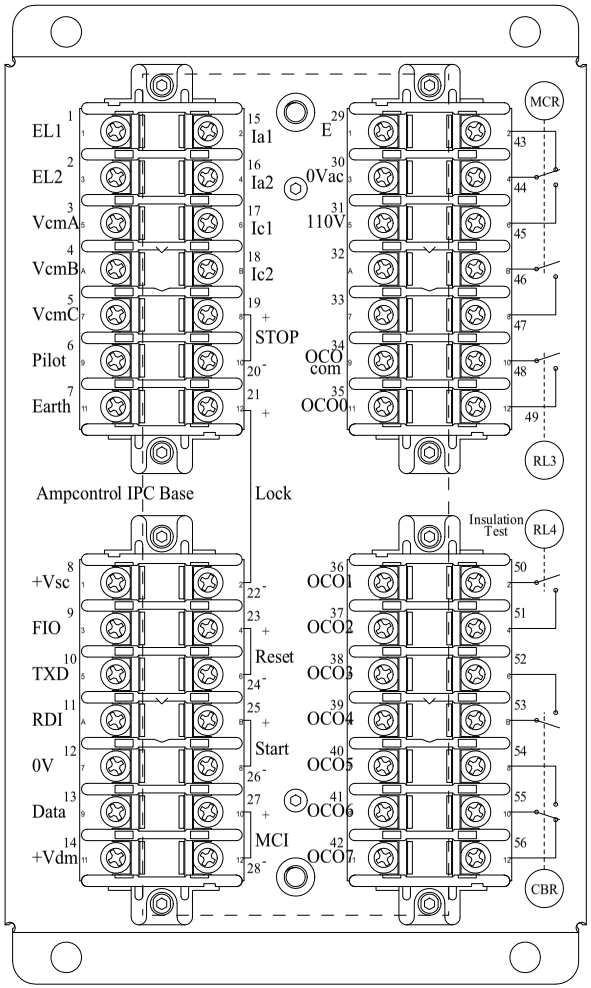
TOP



IPC RELAY

(SILK SCREENED STAINLESS STEEL)

TOP



IPB/IPC BASE

NOTE

1. ENSURE WHEN INSTALLING RELAY INTO BASE THAT TOP OF RELAY MATCHES TOP OF BASE.

REVISION		
0.CRN	5468	17/10/05
1.CRN	7066	22/09/08

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ABN 35 000 770 141
7 BILLBROOKE CLOSE,
CAMERON PARK,
N.S.W. 2285, AUSTRALIA
P: +61 2 4903 4800
electronics@ampcontrol.com.au

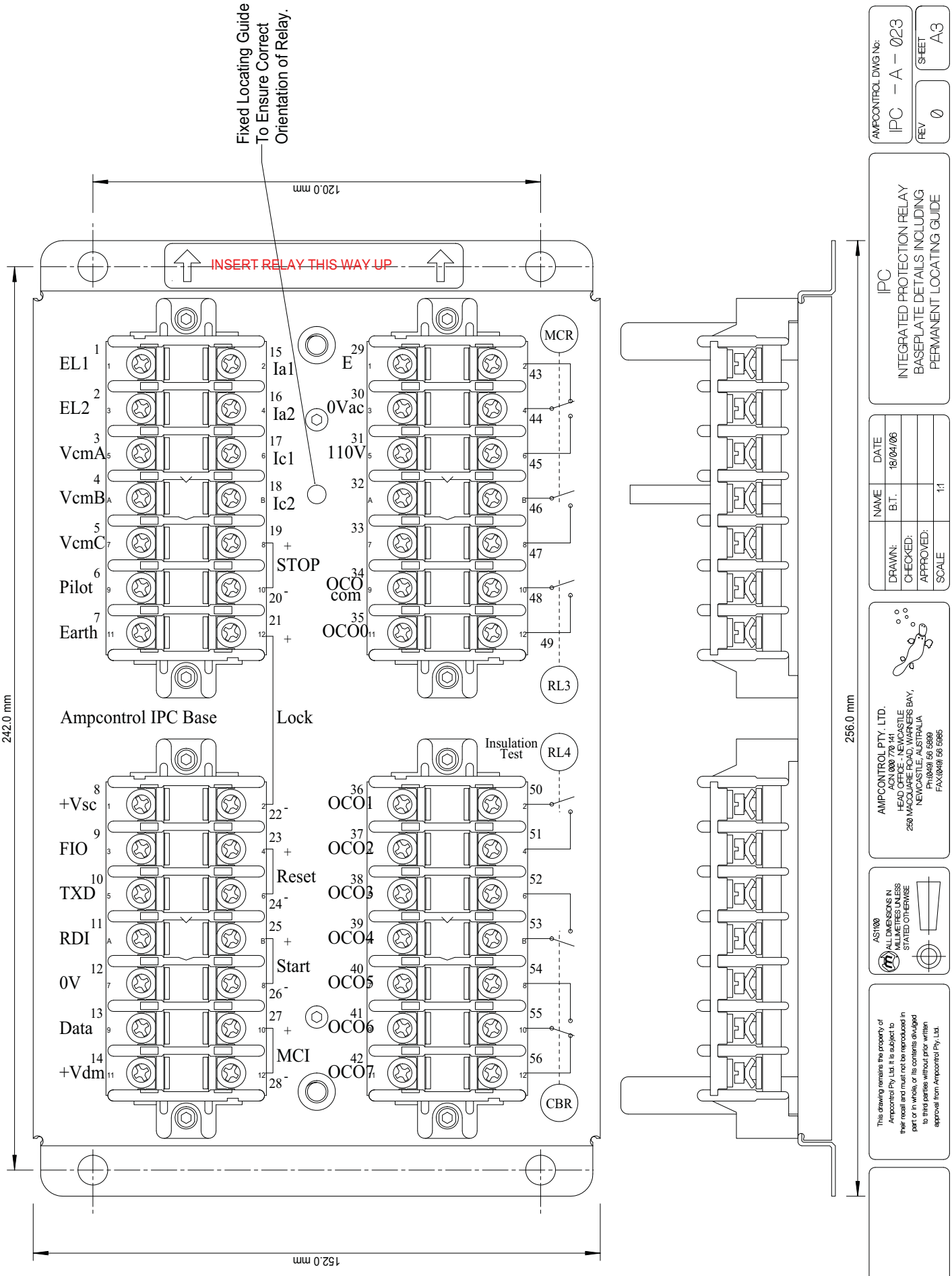
	NAME:	DATE:
DRAWN:	G.R..	17/10/05
CHECKED:	E.C.	12/01/09
APPROVED:	R.B.	21/01/09
SCALE:	1:1	

IPB/IPC
RELAY + BASE
INSTALLATION DRAWING

AMPCONTROL DWG No: IPB – A – 029

REV 1

SHEET A2


Fixed Locating Guide
To Ensure Correct
Orientation of Relay.
120.0 mm
INSERT RELAY THIS WAY UP
242.0 mm
EL1
EL2
VcmA
VcmB
VcmC
Pilot
Earth
Ia1
Ia2
Ic1
Ic2
STOP
Lock
E
0Vac
110V
OCO com
OCO0
MCR
RL3
Ampcontrol IPC Base
+Vsc
FIO
TXD
RDI
0V
Data
+Vdm
Reset
Start
MCI
OCO1
OCO2
OCO3
OCO4
OCO5
OCO6
OCO7
Insulation Test
RL4
CBR
152.0 mm
256.0 mm
AMPCONTROL DWG No:
IPC – A – 023
REV
0
SHEET
A3
IPC
INTEGRATED PROTECTION RELAY
BASEPLATE DETAILS INCLUDING
PERMANENT LOCATING GUIDE
NAME
DATE
DRAWN:
B.T.
18/04/06
CHECKED:
APPROVED:
SCALE
1:1
AMPCONTROL PTY. LTD.
ACN 000 778 141
HEAD OFFICE - NEWCASTLE
259 MACQUARIE ROAD, WARNERS BAY,
NEWCASTLE, AUSTRALIA
Ph:(049) 56 5899
FAX:(049) 56 5985
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0 CRN 5546
18/04/06

WARING ENGINEERING SERVICES PTY LTD.
51 Regal Way, Valentine. NSW 2280
Phone / Fax **0249 46 5500**
Mobile **0429 331879**
gwaring@telstra.easymail.com.au
ABN 87 077 639 984

File No : C92/0362

The Manager,
AMPCONTROL Pty Ltd.
250 Maquarie Road,
Warners Bay, NSW. 2282

Attention : ***Mr Darryl Peacock***

Wednesday, September 05, 2001

RE: Approval of Apparatus for NSW Coal Mines

Item: **Integrated Protection Relay System**

Type: **Types IPA, IPB and IPC.**

Approval No: **MDA Ex (ia) 10035**

Thankyou for your application regarding assessment of the above equipment for Supplementary Approval. Please find enclosed the following documents in accordance with the DMR directive to AAA approval process:

- Notice of Approval
- Approval Schedule
- Stamped Approval Drawings.

A complete copy of this document has been passed on to the Records Branch of the Dept. of Mineral Resources.

Yours faithfully,

Grant L. M. Waring
Accredited Assessing Authority (MDA-A2516)

New South Wales
Department of Mineral Resources
Accredited Assessing Authority MDA-A2516

COAL MINES REGULATION ACT, 1982

APPROVAL No. **MDA Ex (ia) 10035**
ISSUE No. **A2516-01**
DATE : **5 September, 2001**

NOTICE OF SUPPLEMENTARY APPROVAL

It is hereby notified that the Approved item listed herein has been assessed for compliance with the Coal Mines Regulation Act and appropriate Standards or requirements and is hereby APPROVED in accordance with the requirements of the COAL MINES REGULATION ACT 1982. This approval is issued pursuant to the provisions of Clause 70 and 73 of the Coal Mines (General) Regulation, 1999.

This APPROVAL is issued to	:	**AMPCONTROL CSM Pty Ltd**
Address of Approval Holder	:	**250Maquarie Road, Warners Bay, NSW 2282**
Description of Item/s & Variations	:	**Integrated Protection Relay** **Addition of Relay Type IPC including cable connection modules type CCMC-3.3k and CCMC-1.0k to existing range.**
Manufacturer and model / type	:	**AMPCONTROL CSM Pty Ltd**
C.M.R.A Regulation	:	**Coal Mines (Underground) Regulation 1999** Clause : **140 (1)**
Specific Approval Category (if applicable)	:	**Explosion Protected – Intrinsically Safe Ex (ia)**

This Approval is issued subject to compliance with the requirements of the Occupational Health and Safety Act 2000.

The Authority issuing this Approval has, for the purposes of the Occupational Health and Safety Act, 2000, appended a list of conditions / recommendations, (including drawings, documents, etc.) that are applicable to this Approved Item, as identified during test and / or assessment, to assist the Approval Holder and User to comply with the obligations of the Occupational Health and Safety Act, 2000. The onus is on the Supplier and / or User to ensure the Approved Item, and any deviation from the list of conditions / recommendations, in reference to that Item is not inferior in any way to the Item tested and / or assessed, this includes the supply, installation and continuing use of the Approved Item.

The Approval Number shall appear in a conspicuous place and in a legible manner on each approved item, unless specifically excluded.

A copy of the Approval Documentation shall be supplied to each user of the approved item and shall comprise the number of pages listed in the footer block together with supplementary documentation as listed in the schedule and in respect to drawings, all drawings as listed in the schedule or those specifically nominated for the purposes of repair and maintenance.

Any Maintenance, Repair or Overhaul of Approved Items shall be carried out in accordance with the requirements of the Coal Mines Regulation Act, 1982.

G.L.M. Waring
Accredited Assessing Authority (MDA A2516)
FOR CHIEF INSPECTOR OF COAL MINES

Minerals and Energy House, PO Box 536, St Leonards, NSW 2065, Australia
Telephone: (02) 9901 8888 Facsimile: (02) 9901 8777

New South Wales
Department of Mineral Resources
Accredited Assessing Authority MDA-A2516

COAL MINES REGULATION ACT, 1982

APPROVAL No. **MDA Ex (ia) 10035**
ISSUE No. **A2516-01**
DATE : **5 September, 2001**

SUPPLEMENTARY APPROVAL SCHEDULE

Detailed Description of Approved Item(s) and Variation(s) :

The Integrated Protection Relay Type A (IPA), Type B (IPB) and Type C (IPC) with the associated equipment as listed in Table below, provide electrical protection functions for electrical power circuits in Coal Mines.

ASSOCIATED EQUIPMENT		
Item	**Module Type**	**Protection Category**
1	Cable Connection Module – CCMA – 3.3kV, 1kV, 415V & 110V	Ex (ia)
2	Optional LED / Relay Module	
3	Serial Interface Module – I.P.S.I	
4	Remote Termination Units – RTU-1 and RTU-2.	
5	Communications Interface unit RTU-CIU1	
6	Keypad Interface IKA	
7	Keypad IKA	Ex ia
8	Remote Display Module – RDM-1	
9	Cable Connection Module – CCMC – 3.3kV, 1.0kV & 415	Ex (ia)

Variations:

1. Addition of the Integrated Protection Relay Type C (IPC) and cable connection modules types CCMC – 3.3k and CCMC – 1.0k. The modules enable a meggering function to be performed on the supply cables after the Earth Fault Lockout test is successfully completed.
   The Integrated Protection Relay Type C (IPC) differs primarily from the Integrated Protection Relay Type B (IPB) in firmware and the Earth Fault Lockout output circuitry.
2. Circuit modifications to the remote Display Module, RDM – 1.
3. Circuit modifications to the keypad IKA.
4. Inclusion of alternative relay base connectors.

Compliance Documents :

1. SIMTARS Test Report No NI01/0001 dated 01/06/2001 confirming compliance with AS2380.1 –1989, AS2380.7 – 1987, and AS2081 – 1988 parts 1 to 4 inclusive.
2. Certificate of Conformity AUS Ex 2067 X Issue 6 dated 05/06/2001.

Minerals and Energy House, PO Box 536, St Leonards, NSW 2065, Australia
Telephone: (02) 9901 8888 Facsimile: (02) 9901 8777

Approved Drawings :

As per Schedule on listed compliance document AUS Ex 2067 X Issue 6.

Conditions of Supply and Use :

1. When mounted in a cutout in the wall of an enclosure, the Remote Display Module –RDM-1 shall be mounted such that the enclosure maintains a degree of protection of at least IP54.

   The equipment shall be installed according to AS 2381.1 and AS 2381.7 and satisfy the relevant Coal Mining Electrical Rules.

   The equipment shall be connected to systems where the earth fault current is limited to less than 480A instantaneous peak value for the IPB and IPC relays and 80A for the IPA relay.

   The parameters marked on the IPA, IPB and IPC unit's facia plates and the respective modules shall be observed.

   The RTU-1 Remote Termination Unit, RTU-2 Remote Termination Unit and RTU-CIU1 Communications Interface Module, when in a hazardous area, shall be installed in a flameproof enclosure and connections thereto shall not be considered as intrinsically safe when the power cable is energised.

   The CCMA-110V Cable Connection Module is not to be used for Earth Fault Lockout applications.

2. In addition to the manufacturers performance and routine testing, it is a requirement of safe manufacture that a routine test shall be carried out on each completed Cable Connection Module to ensure correct operation of the diodes and value of the current limiting resistance.

Marking on Apparatus :

1. The manufacturers name or mark, and the approval number **MDA Ex. (ia) 10035** shall be inscribed in a durable manner in a prominent position on the apparatus.

G.L.M. Waring
Accredited Assessing Authority (MDA A2516)
FOR CHIEF INSPECTOR OF COAL MINES

Minerals and Energy House, PO Box 536, St Leonards, NSW 2065, Australia
Telephone: (02) 9901 8888 Facsimile: (02) 9901 8777

Australian/New Zealand
Certification Scheme for
EXPLOSION-PROTECTED ELECTRICAL EQUIPMENT
ANZEx Scheme

Certificate of Conformity

Certificate No.: **ANZEx 08.4071X** Original Issue No.: **0** Date of Issue: **8 March 2009**

Certificate Holder:
Ampcontrol CSM Pty Ltd
7 Billbrooke Close
Cameron Park NSW 2285
Australia

Electrical Apparatus:
Integrated Protection Relay Systems –
Types A (IPA), B (IPB) and C (IPC)
(including equipment as listed in Table 1)

Type of Protection:
IPA, IPB and IPC including items 1 to 6 and 9 (refer Table 1): Ex (ia) I
Items 7 + 8 (refer Table 1): Ex ia I 150C

Marking Code:
(Type of Protection as listed in Table 1)
ANZEx 08.4071X

Manufacturing Location(s):
Ampcontrol CSM Pty Ltd
7 Billbrooke Close
Cameron Park NSW
Australia

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ITACS®
ABN *06 098 886 563*

Certificate issued by

ITACS Pty. Ltd.
***4-6 Second Street SA 5007* Australia**
PO Box 300 Hindmarsh SA 5007 Australia
Phone: +61 8 8346 8680 Fax: +61 8 8346 7072
Email: itacs@itacslab.com

JAS-ANZ
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*This certificate is granted subject to the conditions as set out in Standards Australia/Standards New Zealand Miscellaneous Publication **MP87:2004**.*

STANDARDS:

The electrical apparatus and any acceptable variations to it specified in the schedule of this certificate and the identified documents, was found to comply with the following standards:

AS 2380.1:1989 inc Amdt No. 1	Electrical equipment for explosive atmospheres Explosion protection techniques Part 1 : General requirements
AS 2380.7: 1987	Electrical equipment for explosive atmospheres Explosion protection techniques. Part 7: Intrinsic Safety

*This Certificate **does not** indicate compliance with electrical safety and performance requirements other than those expressly included in the Standard(s) listed above. Attention is drawn to the fact that the above Standards have been superseded.*

ASSESSMENT & TEST REPORTS:

The equipment listed has successfully met the assessment and test requirements as recorded in:

Test Report No. and Issuing Body:	**Refer to Schedule**
Quality Assessment Report No. and Issuing Body:	**IECEx AU/TSA/QAR06.0007/02**
File Reference:	**ANZEx 08.4071X**

Signed for and on behalf of issuing body

8 March 2009

Date of Issue

Certification Authority

Position

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This certificate is not transferable and remains the property of the issuing body and must be returned in the event of it being revoked or not renewed.

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Schedule

EQUIPMENT:

The Integrated Protection Relay Type A (IPA), Integrated Protection Relay Type B (IPB) and Integrated Relay Type C (IPC), with associated equipment as listed in Table 1 below, provide electrical protection functions for electrical power circuits in coal mines.

Table 1. Associated Equipment

ITEM	Module Type	Category
1	Cable Connection Module – CCMA – 3.3KV, 1000V, 415V + 110V	Ex [ia]
2	Optional LED/Relay Module	
3	Serial Interface Module – I.P.S.I	
4	Remote Termination Units – RTU-1 and RTU-2	
5	Communications Interface Unit RTU-CIU1	
6	Keypad Interface IKA	
7	Keypad IKA	Ex ia
8	Remote Display Module – RDM-1	
9	Cable Connection Module – CCMC – 3.3kV, 1.0kV	Ex [ia]

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ANZEx Scheme

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TEST REPORTS:

Test Reports applicable to the product and systems covered by this certificate include:

Test Laboratory	Test Report	Equipment
SIMTARS	NI94/0021 NI92/0106 NI93/0005 NI93/0041 I94/0529	Integrated Protection Relay Systems Type A & B
SIMTARS	NI95/0023 NI92/005 I92/018 NI94/0021	Integrated Protection Relay Systems Type A & B
SIMTARS	NI96/0030	Integrated Protection Relay Systems Type A & B
SIMTARS	NI97/0006	Integrated Protection Relay Systems Type A & B
SIMTARS	NI97/0032	Integrated Protection Relay Systems Type A & B
SIMTARS	I98/0012	Integrated Protection Relay Systems Type A & B
SIMTARS	NI01/0001	Integrated Protection Relay Systems Type A,B & C
SIMTARS	9689A	Serial Interface Module for IPA-IPSI

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CONDITIONS OF CERTIFICATION:

The following conditions apply to this certificate:-

Conditions of manufacture

1. In addition to the manufacturer's performance and routine testing, it is a requirement of manufacturer that a routine test shall be carried out on each Cable Connection Module to ensure correct operation of the diodes and the value of the current limiting resistance.

Conditions of safe use

1 When mounted in a cut-out in the wall of the enclosure, the Remote Display Module RDM-1 Shall be mounted such that the enclosure maintains a degree of protection of at least IP54.

2. The equipment shall be installed according to AS/NZS 2381.1 & AS 2381.7 and satisfy the Coal Mining Electrical Rules.

3. The equipment shall be connected to systems where the earth fault current is limited to less than 480A and instantaneous peak value for the IPB and IPC relays and 80A for the IPA relay.

4. The parameters marked on the IPA, IPB and IPC units facia plates and respective modules shall be observed. Entity parameters for the CCMC are listed below;

Entity Parameters				
Config.	**Uo** (V)	**Io** (μA)	**Group I**	
			Co (μF)	**Lo** (mH)
A	24.5	3.3	4.2	1000
B	24.5	9.9	4.2	1000
C	24.5	19.8	4.2	1000

Config.

A Single CCMC single output channel – Earth

B Single CCMC all three channels parallel connection – earth

C Two CCMC all six channels parallel connection – earth

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5 The RTU-1 Remote Termination Unit, RTU-2 Remote Termination Unit RTU-CIU1 Communications Interface Module, when in a hazardous area, shall be installed in a flameproof enclosure and connections thereto shall not be considered intrinsically safe when the power cable is energized.

6. The CCMA-110V Cable Connection Module is not to be used for Earth Fault Lockout applications,

MANUFACTURER'S DOCUMENTS:

Number	Title	Rev	Date
A1708-0 Sheet 1 of 8	IPA SCHEMATIC - TERMINALS	4	1992-04-10
A1708-13	IPA Base Terminal Pin-out	2	1992-04-06
A1708-14	IPA Block Diagram	2	1992-04-06
A1708-15	IPA Typical Connection Diagram	4	1992-04-21
A1708-16	IPA SERIAL I/O PORTS CONNECTIONS	4	1992-04-24
A1708-17	IPA Enclosure	3	1992-04-21
A1708-21	IPA 1000V LINE CONNECTION MODULE CONSTRUCTION DETAILS	2	2008-12-03
A1708-22	IPA 415V LINE CONNECTION MODULE CONSTRUCTION DETAILS	2	2008-12-03
A1708-24	IPA CABLE CONNECTION MODULE 1000V ARTWORK DRAWING	1	2008-12-08
A1708-25	IPA CABLE CONNECTION MODULE 415V ARTWORK DRAWING	1	2008-12-03
A1708-27	IPA 1000V LINE CONNECTION MODULE (DIMENSIONS & MARKING)	2	2009-02-16
A1708-28	IPA 415V LINE CONNECTION MODULE (DIMENSIONS & MARKING)	2	2009-02-16
A1708-31	IPA REMOTE DISPLAY MODULE ARTWORK & TERMINAL MARKINGS	1	1992-04-06
A1708-38	IPA Proc, Board ARTWORK DRAWING	2	1992-07-28
A1708-44	IPA 3.3kV INTERFACE CCMA 3.3kV CONSTRUCTION DETAILS	3	2008-12-03
A1708-9	IPA: I.S. Components	2	1992-07-29
IKA-A-005	IKA KEYPAD MARKING DETAILS	3	2009-01-21
IKAM002	IKA INTERFACE MODULE GENERAL DETAILS	3	1994-02-11
IKA-S-001	IKA INTERFACE MODULE SCHEMATIC	3	2008-12-03
IKA-S-002	IKA Keypad Schematic	3	2008-10-01

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Number	Title	Rev	Date
IKA-S-003	IKA INTRINSIC SAFETY COMPONENTS	4	2008-12-03
IKA-S-004	IKA INTERFACE UNI1 ARTWORK DRAWING	1	2008-12-03
IKA-S-005	IKA I.S. Keypad Module Artwork Detail	4	2008-10-01
IKA-Z-001	IKA SYSTEM MARKING DETAILS - APPROVAL DRAWING	1	2009-02-16
IPAS005	IPA Relay/Led OUTPUT Module Details	2	2009-02-04
IPA-Z-001	IPA Marking Details - Approval Drawing	1	2009-02-16
IPA-Z-002	CCMA-110V Marking & Dimension Details	1	2009-02-16
IPA-Z-003	CCMA-110V Construction Details	0	2008-12-03
IPA-Z-004	IPA I.S. Components	1	2009-01-06
IPB-E-003	IPA-IPB CIU/1 – COMMS INTERFACE MODULE SCHEMATIC	0	2008-12-03
IPB-Z-001	IPB SCHEMATIC – ALNANLOGUE BOARD - IPNUTS	1	2008-12-03
IPB-Z-002	IPB Schematic - Analog Board - Coms	0	1994-10-24
IPB-Z-003	IPB Schematic - Processor Board, Sheet 1 -Inputs	0	1994-10-24
IPB-Z-004	IPB Proc, Board, Sheet 2 –A/D	0	1994-10-24
IPB-Z-005	IPB Processor Board, Sheet 3 -Processor	0	1994-10-24
IPB-Z-006	IPB Processor Board, Sheet 3 -Battery/RAM/Clock	0	1994-10-24
IPB-Z-007	IPB Schematic - Power Supply Board	0	1994-10-24
IPB-Z-008	IPB Schematic - Relay Board	0	1994-10-24
IPB-Z-009	IPB SCHEMATIC - REMOTE TERMINATION UNIT - SHEET 1	0	2008-12-03
IPB-Z-010	IPB RELAY Analog Baord PCB APPROVAL DRAWING	0	2009-01-06
IPB-Z-011	IPB RELAY Processor, Power & RTU Boards PCB APPROVAL DRAWING	1	2008-12-01
IPB-Z-012	IPB MARKING DETAILS - APPROVAL DRAWING	3	2009-02-16
IPB-Z-013	IPB BASEPLATE DETAILS	0	2009-01-06
IPB-Z-014	IPB I.S. Components Approval DRAWING	2	2009-01-06
IPB-Z-015	IPB Typical Connection Diagram	2	2009-01-06
IPB-Z-016	HM7231.3 Transformer Construction Details	1	2009-02-16
IPB-Z-017	IPB RTU UNIT ENCLOSURE/MOUNTING DETAILS	0	2009-01-06

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Number	Title	Rev	Date
IPB-Z-018	IPB Schematic - Remote Termination Unit - sheet 2	0	1994-10-28
IPB-Z-019	IPB-CIU CASE DETAILS APPROVAL DRAWING	0	2008-12-03
IPB-Z-020	RTU-CIU1 ARTWORK DETAILS APPROVAL DRAWING L3	0	2008-12-03
IPB-Z-023	IPB RTU-2 CONSTRUCTION DETAILS	1	2009-02-16
IPB-Z-024	RTU-2 SCHEMATIC - SHEET 1 L3	0	2008-12-03
IPB-Z-025	RTU-2 SCHEMATIC - SHEET 2	0	2008-12-03
IPB-Z-026	IPB RTU-2 - APPROVAL MARKING DETAILS	1	2009-02-16
IPB-Z-028	RDM-1k REMOTE DISPLAY MODULE GENERAL ARRANGEMENT & MOUNTING DETAILS	1	2009-02-16
IPC-Z-001	IPC 3.3kC CCMC Schematic	0	2008-09-30
IPC-Z-002	RDM1 Schematic	0	2008-09-30
IPC-Z-003	IPC CCMC-3.3k Dimension & Marking Detail	0	2008-10-01
IPC-Z-004	IPC CCMC-3.3k Construction Details	0	2008-10-01
IPC-Z-005	IPC Typical Connection Diagram	0	2008-10-01
IPC-Z-006	IPC 1000V CCMC Construction & Artwork Detail	0	2008-10-01
IPC-Z-007	IPC 1k CCMC Schematic	0	2008-09-30
IPC-Z-008	IPC 1000V CCMC Dimension & Marking Details	0	2008-10-01
IPC-Z-009	IPC 3.3kV Artwork Detail	0	2008-10-01
IPC-Z-010	IPC Analog Board V3.0 Schematic	0	2008-09-30
IPC-Z-011	IPC Analog Board Inputs V3.0	0	2008-09-30
IPC-Z-012	IPC Analog Board Coms V3.0	0	2008-09-30
IPC-Z-013	IPA/IPB/IPC Relay Base DETAILS	0	2008-10-01
IPC-Z-014	IPC Relay Base Details	0	2008-10-01
IPC-Z-015	IPC Facia Marking DETAILS	1	2009-02-16
IPC-Z-016	IPC Analog Board Artwork Detail	0	2008-10-01
IPC-Z-017	IPC Processor Connections	0	2008-09-30
IPC-Z-018	IPC Processor Inputs	0	2008-09-30
IPC-Z-019	IPC Processor ADC	0	2008-09-30
IPC-Z-020	IPC Processor CPU	0	2008-09-30

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Number	Title	Rev	Date
IPC-Z-021	IPC Processor Battery	0	2008-09-30
IPC-Z-022	IPC RDM1 Artwork Detail	0	2008-10-01
IPC-Z-023	IPC Earth Leakage Shunt DETAILS	0	2008-10-01
IPC-Z-024	IPC 415 CCMC Schematic	0	2008-09-30
IPC-Z-025	IPC 415V CCMC Dimension & Marking Details	0	2008-10-01
IPC-Z-026	IPC RTU-2 MARKING DETAILS	0	2008-12-22
IPSC-Z-005	IPSC MARKING DETAILS - APPROVAL DRAWING	1	2009-02-16
IPSI-A-002	SERIAL INTERFACE MODULE - IPSI MECHANICAL DETAILS	2	2008-12-03
IPSI-A-003	SCIENTECHNIC IPSI ISOLATION BOARD PRINTED CIRCUIT ARTWORK DETAIL	0	2008-12-03
IPSI-M-001	SCIENTECHNIC SERIAL INTERFACE MODULE - IPSI TRAFFOLYTE LABEL DETAILS	1	2008-12-03
IPSI-S-001	SCIENTECHNIC SERIAL INTERFACE MODULE – IPSI CONNECTION DIAGRAM	0	2008-12-03
IPSI-S-002	SCIENTECHNIC PROTOCOL RELAY_IPSI OPTO-COUPLER BOARD SCHEMATIC	0	2008-12-03
IPSI-Z-001	IPSI OPT110 ARRANGEMENT	0	2008-12-03
IPSI-Z-004	AMPCONTROL IPSI INTERNAL CONSTRUCTION	2	2008-12-03

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